THURSDAY, MARCH 25, 1880

THE INSTITUTION OF NAVAL ARCHITECTS

THE recent annual meeting of the Institution of Naval Architects was remarkable chiefly for the number of interesting papers affecting the mercantile marine. There were three of special interest, viz., "On Causes of Unseaworthiness in Merchant Steamers," by Mr. Benjamin Martell, Chief Surveyor to *Lloyd's Register;* "On Cellular Construction of Merchant Ships," by Mr. W. John, also of *Lloyd's Register;* and on "Steel in the Shipbuilding Yard," by Mr. W. Denny, of the well-known firm of W. Denny and Bros., Shipbuilders on the Clyde.

The subject of Mr. Martell's paper was, in view of the recent agitation in Parliament and elsewhere, deemed of such importance that the Council, contrary to the usual rule, devoted the whole of one day to its discussion. Certainly no better authority could be found to guide public opinion in forming a correct estimate as to the true causes of the numerous recent losses of grain-laden vessels, than the author of this paper. The public, led in this matter by the not too-well informed zeal of Mr. Plimsoll, has too hastily ascribed these losses to the prevalent custom of lading grain in bulk, without adequate provision having been made for preventing the shifting of the cargo to one side, or the other, of the vessel, in case heavy weather should be encountered. Without ignoring this cause of loss in ill-designed vessels, Mr. Martell takes a far wider view of the matter, and ascribes these numerous disasters to the following ten principal sources:—

"1. Weakness of structure from deficient scantlings, combined with faulty construction in arrangement and workmanship, together with inferiority of material.

"2. Deterioration, causing local defects and unseaworthiness.

"3. Absence of proper control over cocks, valves, and pipes connecting the engines and boilers with the sea. Also a want of proper arrangement of bilge pump suctions, and of suction pipes from sea and bilge, whereby water, from inadvertence or carelessness, can be run from the sea into a vessel.

"4. Faulty and deficient pumping arrangements, preventing the accumulated water being pumped from the wings in turn of bilge, after a vessel, from shifting cargo or other cause, has become inclined.

"5. Breaking down of machinery, and the consequent falling off of the vessel into the trough of the sea.

"6. Bad navigation—leading to collision or vessels running ashore.

"7. Inefficient protection of openings in the deck.

"8. Hasty and improper loading, particularly of grain cargoes in bulk, and deficiency of shifting boards or bulkheads, or other means to prevent cargo from shifting.

"9. Disproportionate dimensions of steamers, combined with undue height of double bottom, thereby causing, with some description of cargoes, deficiency of stability.

"10. Overloading."

Each of the foregoing causes has no doubt at some time or other claimed its victims, but as the first six are thoroughly well understood already, the paper deals chiefly with the fifth and the last four.

The breaking-down of machinery has probably been the cause of more disasters than is generally suspected. It is well known that the first-class Transatlantic steamers, provided with the most powerful engines, have often in very heavy weather as much as they can do to keep their course in safety. It will readily be seen that under-engined cargo steamers must under similar circumstances adapt themselves to a safe and practicable course, and can, when steaming full power ahead, only just manage to keep their positions, and may even in spite of all exertions drift astern. If in these cases the engines thus heavily strained become temporarily disabled, the vessel will refuse to answer her helm, and she will inevitably fall off into the trough of the sea, and be placed in the greatest danger. The same thing will happen, even if the engines work well, provided anything goes wrong with the stearing-gear, which is often of an intricate character.

The seventh source of danger, viz., inefficient protection of openings in the deck, should be, one would think, easy enough to provide against, by properly covering and inclosing all hatches, stokeholds, &c. But the inclosing of these spaces is discouraged by the operation of the Tonnage Laws. The following extract will throw light on this question:—

"The same may be said of the protection round the openings of the engine and boiler space. The best protection possible is an inclosed bridge house around the engine and boiler openings; but as the law at present stands, it encourages the ends of this bridge superstructure being left open instead of being closed by iron bulkheads.

"I was much struck with this a few months ago, when I officially visited a large number of steamers in course of construction in the North for the Atlantic trade, and on pointing out to the owners or builders the desirability of continuing the bridge house to the sides of the vessel, and inclosing it so as to secure effectively the casings round the engine and boiler openings against heavy Atlantic waves, I was invariably met by the observation that it would add too much to the working expenses of the ship, as this space would be measured for tonnage."

This clearly is a case for legislative improvement.

The eighth cause, viz., the improper loading of grain cargoes, is the one which, above all others, engrosses public attention at the present time. There is no doubt but that grain, when loaded too hastily in bulk, will settle very considerably, thus leaving empty spaces between the upper surface of the grain and the decks, rendering the cargo liable to shift in bad weather. In such cases, *if the vessel have but a small margin of stability*, she may only too probably capsize. Mr. Martell describes the method of loading and packing grain in various types of steamer, and the means which are adopted in order to prevent the cargo in the hold from settling and from shifting. The efficacy of these means depends largely upon the way in which they are carried out. It is commonly supposed that by carrying the grain wholly in bags, this source of loss would be obviated completely. Mr. Martell, however, tells us that a cargo composed partly of grain, and partly of bags, can be made just as safe as one containing nothing but bags; and that on the other hand the loading of all grain in bags will not cure the evil, if the vessel be deficient in stability, and if the other causes of danger be overlooked.

This question of deficient stability seems to us of the most vital importance, and we commend the following expression of opinion of Mr. Martell to the attention of Mr. Plimsoll and the Board of Trade:—

"In fact, the figures themselves in the Table of Losses show that there were as many coal-laden steamers as grain-laden steamers lost during the months of the past winter; and although it is possible for coal to shift similarly to grain, it is not a cargo which is prone to shift, or which would be considered dangerous in a fairly-designed vessel. In view of these facts there is nothing to show that the inherent deficiency of stability of the vessels, loaded as they were, might not have been as active an agent, if not a more active agent, in creating the disasters we deplore, as the shifting of the cargo."

It is pretty evident from the author's remarks that many of the steamers at present employed in the grain-carrying trade are ill-proportioned for this purpose; though their stability would be amply sufficient when carrying heavy non-homogeneous cargoes properly stowed. The remedy proposed for new vessels is greater beam and a higher freeboard, combined with a depth of double bottom just sufficient for the purposes of water ballast. For existing steamers of a dangerous type, the only remedy is judicious stowage. This may perhaps best be effected by lessening the weight of cargo between decks, and by bringing the vessel back to the load-line, by introducing a corresponding quantity of water ballast into the tanks in the hold. The only inconvenience of this course would be to sacrifice a small fraction of paying freight; a trifling consideration when compared to the greater security to human life.

The problem of designing these vessels so as to suit the peculiarities of all kinds of cargoes is by no means easy. The requirements of a vessel which has only to carry heavy dead-weights stowed low, and one which carries a homogeneous cargo, like grain or coal, with a high centre of gravity, are very different; and when the same vessel has at different times to carry each description of loading it becomes necessary to effect a compromise between too much stability in the first, and too little in the second case. In such cases it is best to err on the side of too much stability, and to correct this quality when heavy dead-weight cargoes are carried by raising the weights as far as possible.

Mr. John's paper "On Cellular Construction of Merchant Ships" is interesting, as describing a recent return to the system of longitudinal construction, first introduced by Mr. Scott Russell over thirty years ago, and carried out by him in numerous iron vessels, notably the *Great Eastern* and the *Annette*. Mr. Scott Russell first invented this system in order to supply a great want in the iron vessels of that day, viz., deficient longitudinal strength. Since then, however, the longitudinal strength of merchant ships has been amply provided for by the introduction of solid keelsons, skin platings, and of iron decks. The present reaction in favour of a longitudinal system of construction is, as Mr. John is careful to inform us, due not to the necessity for providing additional strength, but to the opportunities which it gives of incorporating water ballast tanks into the structure of the bottom of the vessel. The details of this paper, which is one of great interest and importance to practical shipbuilders, are of too technical a character to be put before our readers.

There are few questions of more practical importance to both shipbuilders and owners at the present time, than the substitution of steel for iron in the construction of ships. The greater strength of the new material renders lightened scantlings possible, and the weight thus saved in a vessel's hull represents so much addition to its cargo-carrying capacity. Mr. Denny's paper "On Steel in the Shipbuilding Yard" is a most valuable record of his firm's experience in the use of steel, and it will be a subject for sincere congratulation to all those who are interested, that Mr. Denny has pronounced the new material to be absolutely trustworthy in every respect, far more so indeed than wrought iron. At present the most vexed question in connection with the use of steel is, what limits of tensional strength shall be allowed. If it be wished materially to reduce the scantlings of vessels it is clear that a material of much greater tensional strength than ordinary wrought iron must be made use of. On the other hand the milder and more trustworthy the steel the lower is its strength in this respect, while very strong steels are proverbially hard and brittle. The Admiralty and the two great classification societies, viz., Lloyd's and the Liverpool Underwriters' Registry, have each at present different limits of tenacity. The Admiralty require that the breaking strength shall be between 26 and 30 tons per square inch; Lloyd's between 27 and 31; while the Liverpool Underwriters fix the limits between 28 and 32 tons. The question as to which of these pairs of limits is the best, was mooted both by Mr. Denny and by Mr. West, the Chief Surveyor to the Liverpool Underwriters, who followed Mr. Denny with a paper on "Steel for Shipbuilding." Both speakers inclined to the higher limits; in fact Mr. West went so far as to propose a minimum limit of 30 tons, and to have no maximum limit. He considers that a maximum limit is unnecessary, because the temper-bending tests in common use amply demonstrate whether or no the steel possesses the requisite ductility.

On the other hand Dr. Siemens, under whose patents most of the steel used in shipbuilding is manufactured, spoke strongly during the discussion in favour of the milder and more ductile material. His grounds for doing so were that the extensibility and strength of each variety of the material were the same up to strains of 15 tons per square inch, and that this strain is a long way beyond anything which the material would have to bear in practice.

There were only two papers of any importance bearing on the subject of the Royal Navy. The first was by Mr. Barnaby, and was a description of the *Nelson* class of protected cruiser. There are two of this class in existence at the present time, viz. the *Nelson* and the *Northampton*. They were originally designed as improvemements on the *Bellerophon* and the *Iron Duke*, and viewed from this point they embody many novel features, constituting no doubt great improvements. The protecting armour in the newer vessels is much more partial than in the older ones, but where it is applied the average thickness is 7·28 inches, as against 5·28, representing nearly double the protecting power. Again, the coal-carrying capacity of the *Nelson* and her sister-ship is 1,200 tons, as against 645 tons for the *Bellerophon* and 460 tons for the *Iron Duke*. This is a most important improvement. In fact the two last-named vessels with their small coal-carrying capacity hardly deserve the name of cruisers at all. The armament

of the new ships both in total weight as well as in weight of projectiles fired from the broadside, and right ahead and astern, is much superior to the older two.

Mr. Scott Russell's paper dealt with the true principle of the resistance of armour to shot. Like everything that comes from his pen, it is written clearly and forcibly. It advances for the first time a rational explanation of the great resistance of steel-faced armour-plates as compared with the old-fashioned armour.

In addition to the above many other papers were read, some of them being of great interest and originality. For instance, Mr. MacFarlane Grey's paper "On the Simplification of the Thermodynamics of Steam," which however much we may object to the word *simplification* in the title, is nevertheless a singularly bold and original attempt to account for many of the phenomena of steam and other effects of heat when applied to matter. Want of space however prevents our reviewing this paper in the way it deserves. The same remark applies to Mr. Merrifield's description of Prof. Amsler Laffon's new instrument for calculating simultaneously the area, the statical moment, and the moment of inertia of any closed figure.

Upon the whole the Institution of Naval Architects must be congratulated upon the very valuable and interesting nature of its transactions. It is only to be regretted, that on account of the large number of papers and the limited time for the meetings, so little time is often left over for discussion.

THE LOCAL ENDOWMENT OF RESEARCH

BIRMINGHAM enterprise and Birmingham manufactures are known all the world over. One of the present remarkable features of this hard-working provincial town is a gradual infusion of the apparatus of scientific culture not before its time. Thus we have now a potential, college, to say nothing of an increase in the number of its educational institutions and scientific societies. One of the most recently founded of these institutions is the Birmingham Philosophical Society—a title which one is apt to associate with respectable dulness—a circulating library, and a well-stocked reading-room. But the Birmingham institution, founded only in 1876, is something very different, and bids fair to rival her well-known Manchester sister. Already has the Society published a third thick part of its *Proceedings*, containing a number of original papers that would do credit to a London society.

But Birmingham is nothing if not innovating; her politicians founded a new school of politics, and now her men of science have initiated a new departure in the conduct of scientific societies. This will be plain from the following circular, a copy of which has been sent us:—

"The Council, having taken into consideration the advisability of establishing an Endowment of Research Fund, will submit the following scheme for the consideration of the Society:—

"*Scheme for Establishing and Administering a Fund for the Endowment of Research in Birmingham*

"The Council are of opinion that this Society would be omitting a principal means of the advancement of science—the end for which all such associations exist—if it neglected the question of the endowment of research. To maintain a successful investigator in his labours, even though no results of immediate or obvious utility can be shown to spring out of them, is of interest to the community at large. Indeed it is just because the practical usefulness of such work is not immediate or obvious that it becomes necessary to give special support; for, otherwise, it would have its own market value, and endowment would be superfluous. But the proper and effectual administration of an endowment fund is perceived to be so beset with difficulty as often to deter even those who recognise the principle, from advocating it in practice. Most of the dangers usually foreseen would, however, as a rule, be avoided, simply by the distribution of such funds from local centres, under such a scheme as is now proposed.

"The Council are therefore anxious to establish a fund, in connection at once with the Society and the town, for the direct endowment of scientific research. And they are further of opinion that the eminent merits of Dr. George Gore, F.R.S., as an investigator of exceptional originality and success in the domain of chemistry and physics, clearly point him out as fittest to be the first recipient of endowment from the fund. In accordance with these views the Council propose the following regulations for the fund:—

"1. That the fund be entitled, 'The Birmingham Endowment of Research Fund.' 2. That contributions be invited, payable either at once, or in instalments distributed over a term of years, as individual subscribers may desire. 3. That the money collected be deposited with the Birmingham Banking Company, in the name of the Council of the Birmingham Philosophical Society; and that all cheques on this fund be signed by the president, the treasurer, and one of the secretaries for the time being. 4. That the management of the fund shall be in the hands of the Council of the Birmingham Philosophical Society, who shall have the power of allotting such sums and under such conditions as they may deem fit to any one or more persons engaged in scientific research, for the purpose of assisting them in carrying on their investigations. 5. The Council shall present a report of their proceedings in connection with the fund at the annual meetings of the Society.

"Subject to the approval by the Society of these General Regulations, the Council have resolved—1. That Dr. George Gore, F.R.S., be elected as the first recipient of an endowment from the fund. 2. That in order that Dr. Gore may have greater facilities for continuing in Birmingham his original researches, if the sum collected permit, the amount of 150*l.* per annum for three years be allotted to him. 3. That the first cheque on the sum subscribed be payable on the 1st of July of the current year."

These resolutions were carried unanimously at a full meeting of the Society on the 11th inst. It is not necessary for us to say a word in praise of the important initiative which has thus been taken by one of the youngest of our provincial societies. The lessons to be derived from this action seem plain. Nothing, we think, could conduce more to the encouragement of scientific research in this country than the establishment in the great centres of wealth or industry of funds similar to that with which the Birmingham Philosophical Society have resolved to endow Dr. Gore. To so enormously wealthy a town as Birmingham what is 150*l.* or even 1,500*l.* a year? And need we remind practical Birmingham manufacturers that in their own special lines the most lucrative results have been obtained from investigations that originally had no practical ends in view? Need we also remind them of what during the past few years their balance-sheets have given evidence over and over again,

that this country is fast losing its old industrial supremacy through sheer lack of the scientific knowledge which other countries are turning to such practical account? But it is not on these grounds we would urge the leading scientific societies in our great provincial towns to follow the admirable example set by Birmingham. Scientific research, for its own sake, is a worthy and ennobling pursuit, blessing those that give as well as those that receive the funds for carrying it on, when these are given in a generous spirit and with a discriminating hand. We feel quite sure the Birmingham Philosophical Society would have not only little difficulty in raising the modest sum with which they have ventured to start, but that the wealthy Birmingham manufacturers, and probably even the Birmingham Corporation, will see it to be to their best interests to make the fund a permanent one, and so increase it as to produce wide and substantial results. The example, it is to be hoped, will be followed by other provincial towns, as Manchester, Liverpool, Newcastle, and Glasgow, all of which have reputable philosophic or other similar societies, plenty of money to spare, and everything to gain and nothing to lose by such a wise and noble use of it.

May we not also hope that the example set by this provincial Society will strengthen the weakness of knee which, in the opinion of many, the Royal Society has displayed in its administration of the fund which Government has committed to its care for the endowment of research? At Birmingham the endowment becomes an honour, and not an alms to be sued for on the "proper form," and it is not frittered away so as to miss the real object of the creation of the fund. That some such fund is necessary seems to us clearly proved, if further proof were needed, by the action of the Birmingham Society; and the Royal Society will show itself scarcely worthy of its position as the leading Society of the kingdom and the only Society which demands original research as a condition of admission, if through feebleness or any false sense of dignity it should allow the modest sum it now administers to lapse from its hands. It need not fear that in administering this fund, and in taking all the trouble that must be taken to do so wisely and honestly, it sustains any loss of prestige. There are certain things with which to meddle would certainly be undignified on its part; but in doing work of this kind it seems to us it is performing a proper function.

Perhaps nothing would sooner convince our ignorant and one-sided politicians of the reality of science, and of the necessity for its national recognition than efforts similar to that begun at Birmingham, carried out in all our great industrial centres. In the somewhat humiliating agitation now being carried on all over the country we hear much from both sides of the country's highest welfare; and yet not a single statesman of them all ever gives a hint that he knows what science really means, far less what important national issues depend upon the results of its cultivation. Let our great municipalities take the matter up as Birmingham has done, and we are confident that while much will thus be done for the promotion of scientific research throughout the country, their action will not be without its effect upon the Government. For while such action in the provinces is in the highest degree desirable and laudable, it is no more a substitute for the national recognition of science than municipal government is a substitute for a central administration.

Meantime the Birmingham Philosophical Society, whatever may be the final result of its enterprise, will be entitled to hold an honourable place in the annals of English science.

ECLIPSE OBSERVATIONS

Observations made during Total Solar Eclipses. Collated by A. C. Ranyard, M.A., Sec. R.A.S. *Memoirs* of the Royal Astronomical Society, vol. xli., 1879.

THE idea of collecting different accounts of the same eclipse, and breaking them up, so that all descriptions of one and the same phenomenon should be found side by side, first originated with the Astronomer-Royal, who began to collect all accounts he could procure of the eclipse of 1860. As pressure of work prevented him from carrying out his idea, Mr. Cowper Ranyard took it up at his suggestion and gradually extended the plan, so as to include all the more important physical observations which have ever been recorded during total solar eclipses. This enormous work has now been published in a volume of nearly 800 pages, and there cannot be two opinions as to its usefulness and value. It must, however, be borne in mind that this is a mere work of compilation, and the reader who expects to find a general and correct account of the conclusions to be drawn from the observed phenomena and the results which have actually been arrived at, will be bewildered rather than instructed by the perusal of the book. The volume is simply intended to classify the observations which have been made, and not to discuss them. A good discussion is very much wanted, but it could hardly have been made by a single man, and certainly not without consulting the chief authorities on the subject. It is of course impossible to avoid altogether reference to theories which have been proposed, and their comparison with observations for which they are supposed to account, but Mr. Ranyard has acted in this respect with commendable self-restraint, and whenever he departs from his general rule, he only makes us feel how grateful we ought to be to him, that he has not more often indulged in such vague, confused, and unsatisfactory discussions as here and there disfigure the book. As it is, it will not be difficult to draw a pen through all statements involving debateable matters, and we shall then have a volume which will do credit to its author and to the Society which has published it.

In order to gain an idea of the great variety of observations which are dealt with in the volume, we have only to look over the table of contents.

The first chapters contain accounts of phenomena of minor importance, yet of considerable interest. Most of these can also be observed in partial eclipses, such as the occultation of sun-spots by the moon, the darkness of the moon compared to sun-spots, the fringe round the moon's limb, &c.

Chapter IX. contains an account of the remarkable moving shadow-bands which have been observed just before and after totality. There can be no doubt that these shadows originate in our own atmosphere; but whether the currents which give rise to them are produced by the chilling effect of the eclipse, or whether

they are always present, but only cast a visible shadow when the solar light is confined to a narrow crescent, we do not know. These bands were noticed a short time ago, without an eclipse, in Lord Lindsay's observatory, and were then produced by the sun disappearing behind the mountains. The eleventh chapter treats of the brushes of light apparently emanating from the cusps of the sun during the partial phase. Prof. Stokes has offered an explanation of this phenomenon, and the explanation seems to agree very well with the drawings given by some of the observers. It cannot, however, be reconciled, we believe, with the description given by Mr. Brett, who observed them through his telescope and called them "exquisitely defined."

The subjects of greatest interest and importance of the volume are contained in the three last chapters, which form about two-thirds of the whole volume. They treat of "Polariscopic Observations," "Spectroscopic Observations," and "Photographs and Drawings of the Corona." A good part of the chapter on polarisation may serve as an example of what the book might have been, had Mr. Ranyard more frequently indulged in theoretical speculations. We cannot of course go into any detailed criticism, but shall give two examples in order to justify our remarks. In the first place, we think that Mr. Ranyard has treated the observations which relate to the polarisation of our atmosphere in the parts of the sky occupied by the corona, in a rather careless manner. It appears that one observer makes the polarisation vertical, one horizontal, and seven leave it doubtful whether the polarisation was vertical or horizontal. But on p. 255 all the observations which leave the matter doubtful are given as proving vertical polarisation, and about the one contradictory observation we are told that "it must be borne in mind that a half rotation of his instrument would be sufficient to reverse the position of the colours."

We are then informed that vertical polarisation is exactly what "we should expect." But in a footnote on page 330 we are treated to some vague considerations, from which it "evidently" appears that the polarisation ought to be horizontal or exactly opposite to what we were first led to "expect." And now we are informed that out of eight observations which have been adduced to prove the first statement, seven prove nothing, and the observation which we first had to set aside on account of the "half rotation" is now treated as the only good one. Of the one observation which contradicts this new result we are told that "it seems, perhaps, more natural to assume that he commenced his observations with the polarimeter in a vertical rather than in a horizontal position."

Mr. Ranyard adds that this note must be taken as overriding the opinion expressed on page 255.

What we should "expect" is not at all so "evident" as Mr. Ranyard makes it out to be. If we confine ourselves to clouds, as Mr. Ranyard does, or to the reflection of sunlight from the surface of the illuminated parts of the earth, the polarisation would altogether depend on the distribution of the clouds, it would in all cases be very small, and a small change in the distribution might change the polarisation from one plane to the other. The polarisation due to reflection from unobserved parts of the earth or clouds uniformly covering it, ought to be vertical as we might "expect," in Mr. Ranyard's first statement, and not horizontal, as is "evident" in his second. If the clouds are higher up a different result is possible. There is, however, a second and much more powerful cause of polarisation which is due not to clouds, but to particles which scatter the light without polarising it, but are not sufficiently dense to make the medium opaque or to form a cloud. It is well known that in the neighbourhood of the sun the light is always polarised in a horizontal plane, and the cause we have mentioned seems to be the only one which can account for the facts. Exact observations during total eclipses would be of great use, and might throw some more light on the subject, which has by no means been fully cleared up. A great deal more may be said on this question, but we have only made the foregoing remarks in order to show that the subject cannot be treated in the short offhand way adopted by Mr. Ranyard.

Our second remark refers to a somewhat clumsy mathematical investigation. Mr. Ranyard investigates the polarisation of the light scattered from an atmosphere of particles uniformly distributed within a spherical shell surrounding the luminous point. We may mention that no conclusions whatever can be drawn from this problem with regard to the corona. One of the supposed results, however, of the investigation is that the light coming to us in the direction of the luminous point itself is polarised, and on this result Mr. Ranyard remarks—"At first sight it might appear that at the central part of the corona the light should be entirely unpolarised, but it must be remembered that the illumination of the particles adjacent to C will be very great, and the polarisation of the light dispersed by them will, it appears, overpower the non-polarisation of the light dispersed by the higher parts of the corona." In this passage the atmosphere of particles referred to above is called the "corona," and C is the luminous point. Had Mr. Ranyard ever asked himself the question in what plane the polarisation in the central part of the corona ought to be, the above passage could never have been written, for, reasons of symmetry would have been sufficient to show that no such polarisation is possible. Nor is the reason why the formula breaks down in this particular case far to seek.

We turn with pleasure to the chapter on spectroscopic observations, not that we consider this chapter faultless, but because in it we have brought before us a greater array of facts and not so much theory. For any one who in future eclipses intends to follow up the results achieved with the spectroscope by previous observers, this chapter will be invaluable. In no case is the comparison of different observations of such importance as in spectroscopy, and we are glad to have before us all the evidence, positive and negative, on a great many partly still undecided questions. The last and longest chapter is in some respects the most interesting. In it we have a careful comparison of the more important drawings and photographs of the corona, made during a long series of eclipses. The symmetry of the corona about an axis, nearly coincident with the solar axis, cannot be doubtful any longer, but whether the axis of symmetry is really the sun's axis or only approximately coincident, is one of the important points which will have to be decided during future eclipses.

At the November meeting of the Cambridge Philosophical Society in 1878, I drew attention to some remarkable changes which the outline of the solar corona had undergone during recent years; the change seemed to be periodical, and the period seemed to be that of the sun-spots. In the *Observatory* for December I also made some remarks to the same effect. Pp. 496–501 of the volume before us contain short descriptions of the general shape of the corona during all the eclipses, of which we have drawings, and in all cases information on the number of sun-spots is given.

The result seems to be altogether in favour of such a relation between the two phenomena as I have pointed out. In the papers above referred to, as well as at the November meeting of the Astronomical Society in 1878, I also pointed out a still more remarkable, though perhaps more doubtful, coincidence. It is generally found that the symmetry of the corona is not complete, but that one side is nearly always more fully developed, while the other is more contracted; and this departure from symmetry seems to be related to a direction fixed in space. Thus the eclipses of 1868, 1874, 1875, 1878, which all happened near the minimum of solar activity, resemble each other in general character; but in the eclipses of 1874 and 1875 the east[1] side of the corona was much wider than the west, while in 1868 and 1878 the west side was the broadest. Now the eclipses of 1874 and 1875 happened in April, while the eclipses of 1868 and 1878 happened in August and July. The eclipse of August, 1869, resembles also the two last mentioned in this departure from symmetry, and the eclipse of December, 1871, does not show any decided difference either way. If this remarkable connection of the general outline of the corona with the heliocentric position of the earth at the time of the eclipse should be confirmed, it would tend to show that the outer corona at any rate is of cosmic origin, and this view would be supported if it should be found, as is probable, that the axis of general symmetry of the corona is not exactly coincident with the solar axis. The connection between the sun-spots and corona would, according to this view, be reversed; that is to say, the more disturbed state of the corona at the maximum would not be produced by the increase of sun-spots, but the sun-spots would ultimately be produced by a cosmic cause which has the same period. The next eclipse in 1882 will not unfortunately throw much light on this question, as it will most likely resemble the eclipse of 1870 or 1871.

The great value of the book before us lies in the many suggestions for future observation which offer themselves on its perusal. It teaches some lessons which all of us who have ever observed eclipses or are likely to observe them in future would do well to remember. Thus on reading over the different and often conflicting accounts of one and the same phenomenon, we are struck with the insufficient descriptions of the apparatus and instruments with which the observations have been made. We are told by an observer what he has seen and what he has not seen, but on trying to compare his account with that of others, we generally miss some important information. Observers with the spectroscope, for instance, generally do not tell us anything, or at any rate they do not tell us enough, about the width of slit which they have used and about the luminosity of their spectroscope. Observers with the polariscope speak of bands, vertical or horizontal, and their description generally fails where it is most wanted, and we cannot decide whether a certain polarisation has been observed, or one at right angles to it. We ought, however, to exempt the Washington observers from this general condemnation. The reports emanating from the United States Naval Observatory are generally a model in the accuracy of their accounts.

[1] Owing to a slip it was said in the Report on the Eclipse of 1875 that the west side was the widest in 1874 and 1875.

The preparation of the eclipse volume has necessarily taken a good many years, and it would have been useful if some information had been given as to when different parts of it have been written. The Report of the Eclipse of 1875, for instance, appeared while the work was progressing, and it is natural, therefore, that only those observations could be mentioned which referred to subjects treated in the last few chapters. Yet some information might have been given that the treatment of that eclipse is only incomplete. The remark on p. 373 can only have been written before Mr. Ranyard could have known anything of the results which had been achieved.

As a book of reference to those interested in eclipse observations, the present volume is, as we have already mentioned, of very great value. Our thanks are due to Mr. Ranyard for the great trouble he has taken in its preparation. The blunders contained in it are so obvious, as a rule, that they will hardly mislead any one who is likely to make use of the book. ARTHUR SCHUSTER

NICHOLSON'S TABULATE CORALS

On the Structure and Affinities of the Tabulate Corals of the Palæozoic Period, with Critical Descriptions of Illustrative Species. By H. Alleyne Nicholson, M.D., D.Sc., &c., Professor of Natural History in the University of St. Andrew's. (London and Edinburgh: W. Blackwood and Sons, 1879.)

THIS handsome post octavo volume contains a disquisition on a rather heterogeneous assemblage of organisms partly Cœlenterate and partly Bryozoan in nature, partly of uncertain affinities. Of the palæozoic Cœlenterate corals described, the major portion are probably Alcyonarian. None of them, except perhaps Labechia, appear to belong to the Hydroids, the family of the Hydrocorallinæ being, as far as has yet been discovered, of comparatively recent origin, and not of older date than cretaceous deposits at the most, unless, as believed by Mr. Carter, Stromatopora and its allies of the Silurian formations are in reality closely related to Millepora.

Prof. Nicholson, in the recent edition of his "Palæontology," places Stromatopora amongst the sponges, and does not accept Mr. Carter's conclusions. He seems in doubt about the true relationship of Labechia from the Upper Silurian, the similarity in the structure of which to the Milleporidæ was first pointed out by Dr. Lindström. The author himself, in conjunction with Dr. Murie, was one of the first to investigate the finer structure of Labechia, and described his results in a memoir on the Stromatoporoids, in the *Journal* of the Linnean Society.

The present work commences with a short review of all those corals which possess tabulæ or transverse calcareous partitions within their pores or calicles, and which were formerly grouped together by MM. Milne Edwards

and Haime on that account as a special division of the corals, the *Zoantharia tabulata*.

By the researches of the late Prof. Agassiz, Prof. Verrill, Mr. Moseley, and others, these peculiar structures, the tabulæ, on which MM. Milne Edwards and Haime relied as the foundation of a natural group, have been proved to be of very secondary importance, and to exist in corals of most widely different structure in other and more essential particulars.

Prof. Nicholson, in his preliminary review of the various different forms thus formerly brought together, describes the most important structural details of each, and assigns them to their several places in the animal series. Some, as Heteropora, are, according to the late researches of Mr. Busk, of Bryozoan affinity, and Mr. Busk's results have been so very recently obtained that this fact can only be explained in the book in a note appended to the preface. The Milleporidæ and their allies are Hydroids, the Helioporidæ and Heliolites Alcyonarians, the Pocilloporidæ Madreporarians. The Favositidæ and Syringoporidæ, notwithstanding the close relationship of the latter, in general appearance to the Tubiporine Alcyonarians, the author refers, contrary to the opinion of Dana, Haeckel, and Zittel, to the Madreporaria, expecting "that they will find a place, though a special one, in the series of the *Zoantharia perforata*."

Twelve groups of tabulate corals in all are reviewed, namely, the Milleporidæ, Pocilloporidæ, Favositidæ, Colummariadæ, Syringoporidæ, Auloporidæ, Halysitidæ, Tetradiidæ, Thecidæ, Helioporidæ, Chaetetidæ, and Labechidæ. It is to be hoped that so heterogeneous an assemblage will not be placed again side by side in scientific works, now that the wide differences by which its components are naturally separated are fully known. Succeeding the general introduction there follow in the book a series of chapters devoted to the description of the peculiarities of the families and genera of those of the above cited families of corals which are of Palæozoic age, with detailed descriptions of certain selected types and discussions on the affinities of each family, the affinities being in many cases as yet obscure.

The text is illustrated by excellent woodcuts, and there are fifteen plates containing details of the structures of various forms as exhibited in microscopic sections. The whole cannot but prove of value to specialists who occupy themselves with the investigation of these difficult fossil organisms; but the matter of the book is necessarily too technical in character to allow of detailed review with advantage to the readers of NATURE. Some of the descriptions of types and figures have appeared already in the *Annals and Magazine of Natural History*.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

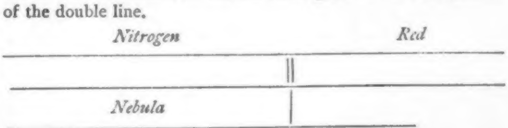
Dissociation of the Metalloid Elements

IN the account given in NATURE, vol. xxi. p. 445, of M. Raoul Pictet's proposal to dissociate the metalloid elements the following reason is given as the ground of his belief that these elements are compounds:—

"The spectrum of the sun when scrutinised with the most elaborate skill and knowledge reveals another very striking circumstance. A large number of the substances regarded by the chemist as elements have now been recognised by the characteristic absorption lines of their spectra as existing in the heated matters surrounding the sun. The researches of Mr. Lockyer show that nearly forty of the metals are thus to be detected. But not a single metalloid is thus discoverable. Indeed so marked is their absence that the presence of hydrogen in such great abundance is held by no less an authority than Mr. Dumas to be a convincing proof that hydrogen is a metal and not a metalloid."

M. Pictet is doubtless unaware that for many years I have advocated the same conclusion. The grounds I have given for this belief are twofold, firstly, that the peculiar chemical reactions of these elements on which the law of even numbers rests leads to this result; and, secondly, that no spectrum of any one of these elements has as yet been found in the light of the sun or fixed stars. Oxygen, I may say, is not included in my list. My first published observations on this subject date from the years 1866–1867 ("Calculus of Chemical Operations," part 1, *Trans.* R. S., 1866, p. 859, and *Chemical News*, June 14, 1867, p. 302). Last year I had occasion to recur to this question, and in an article by myself in the *Philosophical Magazine*, June, 1879, p. 430, the following passage occurs:—

"It is a significant fact that a very large proportion of the class of elements which I have termed composite elements have not been found in the sun. In reply to inquiries on my part Mr. W. Huggins writes to me thus:—So far as I know, nitrogen, phosphorus, arsenic, antimony, boron chlorine, iodine, bromine, have not been found in the sun. In one paper Lockyer suspects iodine. Dr. Miller and I found coincidence of the three lines of antimony with three lines in Aldebaran. Though this observation would show considerable probability of antimony in star, I do not think the spectroscope (two dense prisms of flint glass) was sufficiently powerful to make its existence there certain. In the case of nitrogen, no coincidence was observed in any of the stars. In my paper in the *Transactions* of the Royal Society on Spectra of Nebulæ, I show coincidence of principal line with the strong line in spectrum of nitrogen. Now this line of nitrogen is a double one; and I was not at first able to be certain if the line in the nebula was similarly double. Subsequently with the powerful spectroscope I used for the motions of stars, I was able to make a certain determination of this point (*Proceedings*, R. S., 1872, p. 385). I found the line in the nebula single and coincident with the middle of the less refrangible of the components of the double line.



I say 'middle' because the line in the nebula is narrower and more defined than either of the two lines forming the double line. I made experiments to see if under any conditions of pressure and temperature the more refrangible of the two lines fades out, so as to leave only the one with which the line in the nebula is coincident. I did not succeed. So the matter stands. Is nitrogen compound? Are there any conditions under which the one line only appears? Has the line in the nebula no real connection with nitrogen further than being sensibly of the same refrangibility?

"Now we must either consider that the matter of these elements so abundant on the earth does not exist in the sun or stars (which is hardly probable), or that they have passed into forms of com-

bination in which they cannot be recognised by the spectroscope (which is also hardly admissible at that elevated temperature), or that they have been decomposed."

The important work of Victor Meyer on the behaviour of chlorine and iodine at elevated temperatures which must now be regarded as finally established by the experiments of which an account is given in the recent number of the *Berichte der deutschen chemischen Gesellschaft* (March, 1880), and on which I ventured to offer some theoretical considerations in a paper which appeared in the *J. Chem. Soc.* last autumn, point in the same direction. It is difficult not to admit the force of such a body of coincident evidence as that of which I have here given a brief outline.

March 14 B. C. BRODIE

The Aurora at Last

YESTERDAY, Wednesday, March 17, was a magnificently bright sunshiny day from early morning to latest evening; and at 9 p.m. the aurora appeared, just as it used to do years ago in the last sun-spot cycle, and when that strange influence was in its then vigorous existence. Your readers were warned last October that the sun-spots of the new cycle had then begun "in earnest," and now we have to chronicle the first of their *auroral* fruits.

It was a long low arc of mild quiescent light, about 2° in transverse breadth, 20° long, rising about 7° high in the middle, and sensibly dark between its lower edge and the horizon; the centre was over the north-north-west point of the horizon, but swayed slowly several degrees of azimuth on either side. Towards 11 p.m. the arc began to break up into brighter pellets of light, and these shot fainter rays upwards, making a brilliant and variegated appearance for a few minutes, but apparently soon exhausting itself, for after that there remained only a faint ghostly image of the arc up to 1 a.m.; all this being clearly visible to the naked eye, although a moon seven days old and in 24° N. Decl. was shining brightly in the west.

In the spectroscope, with a narrow slit, nothing but the one inscrutable citron-coloured line appeared, its place in wave-numbers, per British inch, and as ascertained in both hydrogen and carbonic oxide vacuum tubes, being between 45592 and 45690. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, March 18

A Museum Conference

ALLOW me to deprecate most strongly any attempt to form an association having for its object to talk about museums. Museum officials either know their business or they do not. In the former case they have something better to do than to talk; in the second case the less they say the better. The multiplication of conferences threatens to become a nuisance, and special conferences for every grade, class, and description of humanity will soon be proposed by fussy idlers. We shall be told that it is time to have a conference of housekeepers, of lamplighters, of railway guards, boot-makers, beadles, perhaps ballet-girls.

The fact is that endless time and trouble and money are wasted in England in maintaining rubbishing local museums in the care of ignorant and pretentious curators. Conferences are not required, but *proper salaries* for the curators, who should be educated and capable men; were such men secured by adequate salaries they would soon make the museums in their charge very different from what they now are.

A curator with proper salary ought to be made to attend daily at his museum during office hours, and not allowed to leave it to take care of itself whilst he is lecturing here or there, or eking out his pay by literature. ACADEMICUS

I AM glad to see that Mr. Paton has, in NATURE, vol. xxi. p. 442, again revived the subject of a museum conference, and offers to give his aid towards such attaining a practical form. The desirability of a Museum Association was first suggested in an article in NATURE, vol. xv. p. 276, and this was followed by a more definite proposal for a conference by "J. P.," and with the addition of a letter in favour of the same object by Dr. Meyer nothing further was published about it. This looked as if the subject was not considered of any great importance, but I believe many curators were decidedly in favour of it, and only awaited it assuming a practical form to give it their hearty support. The success which has attended the Library Association gives every reason to believe that the formation of a similar association of museum officials would lead to equally good results. Apart from the benefits to be derived from an interchange of ideas and results of experience, which, considering the varied nature of museums and the many practical questions involved in their successful management, could not fail to be considerable, there are many things affecting provincial museums generally that would be greatly advanced by united action. One of these, the distribution of the British Museum duplicates, I should like to refer to. In the British Museum Removals Bill a clause was inserted at the instigation of Mr. Mundella, M.P., and Mr. Chamberlain, M.P., which states that "the Trustees of the British Museum may also give away any duplicate works, objects, or specimens not required for the purposes of the Museum." Instead of giving away, however, I learn that the Trustees are about to *sell by auction* some of the duplicate prints, drawings, &c., in the Museum; and fearing that other duplicates might be disposed of in a similar manner I had the matter brought before Mr. Mundella, who obtained an interview with the Right Hon. Spencer Walpole, Chairman of the Trustees, and was informed that instructions had been given for duplicates in the Natural History Departments to be laid aside and catalogued for distribution among the principal museums. This is somewhat reassuring, but why not treat all their duplicates in this way?—for it should be remembered that provincial towns contribute their share of imperial taxes.

I must not, however, occupy your valuable space with matters that ought properly to be discussed by such a conference as Mr. Paton suggests; and I hope that all who are interested in museums will heartily co-operate with Mr. Paton, whose great success in developing the museum at Glasgow and his extensive acquaintance with museums both in Britain and on the Continent, eminently qualify him to speak with authority on the subject.

Sheffield Public Museum, March 23 E. HOWARTH

A Method of Calculating the Expansion of a Substance on Vaporisation

HAVING occasion last summer to determine the volume of gas which would result from the vaporisation of a given quantity of a certain solid, I made use of a simple way of obtaining approximate results which may not prove uninteresting to some of your readers, unless, as is very likely, they have already made use of it or a better way themselves. For purposes of illustration we may take it that 1 gram of hydrogen gas occupies a volume of 11,200 c.c. at normal pressure and temperature; moreover, the weight of 1 c.c. of water is 1 gm. at 0° C.

Knowing the atomic weight and specific gravity of any liquid or solid, we can now find the volume which 1 c.c. of it will assume on passing into the gaseous state by a simple "rule of three" sum.

For the weight of 1 c.c. of the substance is given by the number which indicates its specific gravity; and the weight of 11,200 c.c. of its gas is given by its atomic weight.

Hence

$$\frac{\text{sp. gr.}}{\text{at. wt.}} \times 11{,}200 = \text{vol.},$$

to which 1 c.c. of the substance expands on becoming gaseous.

It is interesting to note that the fraction $\frac{\text{sp. gr.}}{\text{at. wt.}}$ is the reciprocal of $\frac{\text{at. wt.}}{\text{sp. gr.}}$, which is the expression for the so-called atomic volume (v) of a substance, and thus the expansion of 1 c.c. of a solid or liquid as it becomes gaseous may also be determined by dividing the number 11,200 by the atomic volume of the substance.

In this way we find that 1 c.c. of sodium will occupy 474 c.c. in the state of gas, and 1 c.c. of potassium 249 c.c., or, what is the same thing, 1 c.c. of each of these substances in the gaseous state will occupy $\frac{1}{474}$ c.c. and $\frac{1}{249}$ c.c. in the solid state respectively. But equal volumes of gas under the same conditions of temperature and pressure contain an equal number of molecules, and hence $\frac{1}{474}$ c.c. and $\frac{1}{249}$ c.c., the products of the condensation of equal volumes of potassium and sodium gas must contain an equal number of molecules. From this we readily deduce a real physical meaning for the fraction $\frac{\text{at. wt.}}{\text{sp. gr.}}$, or, in other words, for the expression "atomic volume," the significance of which, at first, was merely conjectured.

Lists of homologous series of elements and compounds, with their "condensation numbers" attached, give very interesting results; I have only one such at hand, which I here give:—

Butyl series.	$\frac{\text{At. wt.}}{2}$	Sp. gr.	Condensation.
$C_4 H_{10}$	29	0·600	231·7
$C_5 H_{12}$	36	0·628	192·3
$C_6 H_{14}$	43	0·669	174·2
$C_7 H_{16}$	50	0·699	156·6
$C_8 H_{18}$	57	0·726	142·6
$C_9 H_{20}$	64	0·741	132·9
$C_{10}H_{22}$	71	0·757	119·4
$C_{11}H_{24}$	78	0·766	110·0
$C_{12}H_{26}$	85	0·778	102·5
$C_{13}H_{28}$	92	0·796	97·0
$C_{14}H_{30}$	99	0·809	91·5
$C_{15}H_{32}$	106	0·825	87·1

From this it will be seen that the amount of condensation of the gas, as it passes into the liquid state, becomes less and less as the molecular composition becomes more complex, and moreover, that the difference in amount of condensation of any two adjacent members of the series becomes diminished at the same time; thus the difference in condensation on passing from butyl hydride to amyl hydride is 39·4; from myristyl to benyl only 4·4 c.c. If the fact that the sp. gr. of these substances has been taken at a common temperature, instead of at their boiling points be considered, it will be seen that the difference is really less marked than it otherwise would be.

From the fact that an increase in the number of atoms in the molecules is accompanied by a decrease in condensation, it would appear that a substance might be found which should possess the same, or nearly the same, specific gravity in the state of gas and solid, *i.e.*, in which these states should become identical. A large number of atoms would have to enter into the formation of a molecule to bring about this result, though if there be any truth in the formula for albumin quoted by Herbert Spencer on the authority of Mulder, it must be approached by this substance. This formula—$10(C_{40}H_{31}N_5O_{12}) + S_2P$—gives us an atomic weight of 3912·5, and if we assume the specific gravity of albumin to be 2, this will give us—

$$\frac{2}{3912} \times 11{,}200 = 5{\cdot}8 \text{ about.}$$

So that 1 c.c. of albumin, on this assumption, would be only about five times as heavy in the colloid as in the gaseous state. This fact may help to throw some light on the peculiar properties of colloids, and taken in conjunction with Herbert Spencer's reflections, on that most curious of all colloids:—protoplasm.

W. J. SOLLAS

A Claim for Precedence

IN reference to the notice of Favre in NATURE, vol. xxi. p. 417, I shall be obliged if you will kindly allow me space for a few remarks.

Credit for much valuable work is given justly to Favre, but I must be allowed to protest against having the few grains of corn belonging to others added to his well-filled granary. One of the discoveries ascribed to Favre in your notice is "the relative diminution in the heat evolved by the combination of a compound body compared with that due to the combustion of its varied constituents," or rather, the cause of it. Now he was not the discoverer of this, but I was. In October, 1851, I published in the *Philosophical Magazine* a paper proving that decomposition absorbs heat, and exactly to the same extent that the previous combination of the constituents had evolved it. I proved it by passing a galvanic current through water and finding the increase of temperature. This gave the heat produced by the resistance lessened by the decomposition of the water. Then, to find the heat of resistance undiminished by decomposition, I passed a similar current, as shown by a galvanometer, through a platinum wire offering the same resistance as the water, and surrounded by an equal quantity as in the first experiment. The difference of temperature in the two experiments was, of course, the heat absorbed by the decomposition.

In some twelve months or so after this publication, Favre and Silberman published in vol. xxxvii. of the *Annales de Chimie et de Physique*, p. 507, the very same experiment to prove the same principle, giving it as their own.

In 1852 a paper from me was read at the Belfast meeting of the British Association, and published the same year, in November, in the *Philosophical Magazine*, giving the first experiments made in thermo-chemistry in which decomposition is taken into account, and showing the principle by which the heat of combination of bodies can be known from that absorbed in their decomposition, and which has since been used in all thermo-chemical researches.

This principle and my experiments were published six months afterwards by Favre and Silberman (*Annales de Chimie et de Physique*, vol. xxxvii. p. 484) without allusion to me.

These publications and dates are easily to be referred to. It is no matter of opinion whether I should be looked on as the originator of thermo-chemistry as it at present stands, but it is a matter of fact that I am, as can be proved by the references I have given; and I think I should not be acting wisely to allow the credit of much labour and thought which is due to myself to be given to another, at least without protest. I do not, of course, want to compare myself with Favre, but I certainly claim, and prior publication establishes for me, the discovery of the principle that originated all the thermo-chemistry of the day which is generally given to him; nor do I expect that I will ever be given as an authority as long as scientific men can quote the names of Favre and Silberman; but I ask that, in fairness, my claim should be put on record, for although it makes very little difference to the world in general who first works out a discovery, yet to the individual whose only gain is the consciousness of having done it, the matter is quite a different thing.

Parsonstown, Ireland, March 9 THOMAS WOODS

The Origin of Man

SEEING that the doctrine of evolution has gained ground now almost universally among naturalists, it is surprising that the problem of the origin of man does not raise up an army of investigators, resolved to establish it by "demonstrative evidence" on an unassailable foundation.

It is true that this question has been engaging the attention of naturalists, and that individual explorers have devoted themselves to its solution, but little, if any, *united* effort has been organised hitherto. Were the matter taken up with as much earnestness as has been brought to bear on explorations in Assyria or Palestine, or in the Rocky Mountains of America, it is hard to believe that this question would long remain unsolved.

If the organisation of a society for the purpose of prosecuting research of the kind above indicated were widely agitated, there would not be wanting, I am convinced, either members or funds to further its success. By a strong united effort—international, if necessary—there is no doubt success would be achieved.

We are not utterly without a clue as to the time and place of man's origin. At least such hints as we possess it is our duty to follow up instead of standing by in idle perplexity as to where research should begin.

We now know that it is useless to look for the remains of Simian man in deposits later than pliocene, since the remains of man—not Simian man, but man truly so-called—have been found in pre-glacial and pliocene deposits in the New World as well as in the Old.

The simple fact of the distribution of man over both eastern and western hemispheres having been accomplished as far back as pliocene times, compels us to suppose that man had probably originated not later than the latter part of the miocene age. The discovery of anthropomorpha (*Pliopithecus* and *Dryopithecus*) in miocene deposits, while as yet eocene strata have only yielded lower members of the primates seems to point to miocene times as somewhat near the date of man's origination. So much for our present clue as to *Time*.

Next as to the Place. Inasmuch as the tertiary formations in the New World have produced hitherto no higher members of the primates than inferior types of monkeys and lemurs, except the recently discovered remains of man himself in pliocene deposits, the inquiry may be confined to the Old World.

In the Old World the most northerly position at which the remains of Anthropomorpha have as yet been found is about the forty-fifth parallel of latitude, namely, in Switzerland and in the south of France.

Now as the higher existing apes are only found in Western Tropical Africa and the Malay Archipelago, while the lower apes (the gibbons) extend into Southern China and Northern India. The migration, since miocene times, of the Anthropomorpha, has probably passed along a grand *Main Line* extending from China through Northern India, Baloochistan, Persia, Asia Minor into the south and south-west of Europe; and from this main line by *Two Branches*: one from Southern China into Malaysia, the other from the region of the Caucasus through Syria, and perhaps Arabia into Africa.

The nearer the form and habits of man in his most primitive stage resembled those of the apes, the more in all probability would his habitat or range have been identical with theirs. Therefore an examination of miocene or early pliocene deposits along this line and its diverging branches would scarcely be unattended with success in producing many fossil remains of very primitive or Simian man.

I trust I have said enough to indicate the direction which inquiry ought to take as far as present evidence goes, and I hope that a gigantic combined effort may ere long be made by all naturalists and all lovers of truth to attempt in a downright earnest manner the solution of this great question of the origin of man.

W. S. DUNCAN

The Stone in the Nest of the Swallow

WOULD any of your readers be kind enough to give me some information about the origin of the fable to which Longfellow refers in the following passage of his "Evangeline," Part I., at the end :—

"Oft in the barns they climbed to the populous nests on the rafters,
Seeking with eager eyes that wondrous stone, which the swallow
Brings from the shore of the sea to restore the sight of its fledglings;
Lucky was he who found that stone in the nest of the swallow!"

Leiden, March 19 P. P. C. HOEK

Carnivorous Wasps

SIR DAVID WEDDERBURN's inquiry (NATURE, vol. xxi. p. 417) reminds me of my experience on this subject. Many years ago I was examining an apple-tree, when a wasp alighted on a leaf which formed a caterpillar's nest neatly rolled up. The wasp examined both ends, and finding them closed, it soon clipped a hole in the leaf at one end of the nest about one-eighth of an inch in diameter. It then went to the other end and made a noise which frightened the caterpillar, which came rushing out at the hole. It was immediately seized by the wasp, who, finding it too large to carry off at once, cut it in two and went off with his game. I waited a little, and saw the wasp come back for the other half, with which it also flew away.

After witnessing such evidence of intelligence I have had a great respect for wasps, and gave orders to my gardeners never to destroy one.

I gained some further evidence of their carnivorous taste when I once took my children to Switzerland for a holiday, and on a butterfly hunting expedition. We had spread out the day's find in the evening, and next morning I placed the boards in the sun to dry. On looking at them some hours later I found nearly all the bodies gone, only the thorax and wings left; and while examining them a wasp alighted on the board, and I soon proved that he was the culprit.

I have no doubt that wasps are most serviceable to gardeners by destroying caterpillars. R. S. NEWALL

March 21

Intellect in Brutes

SOME time since I observed the following conduct of two spiders, which will show how they sometimes overcome difficulties in the way of capturing their prey. A rather large house-spider had its web in the corner of a room, and during the summer it feasted upon the insects that were unlucky enough to be caught. One evening I noticed a large dipterous insect strike the web; the spider darted out and succeeded in fastening one foot of the fly. The spider then kept running back and forth, attaching a thread to a wing, then to a leg, which was soon broken by the violent efforts of the fly to release itself. The spider worked without ceasing for over half an hour to secure its victim; it then quitted operations, and retired to a distant corner of its web. After seeming to reflect for a while what was best to do, it left the web, went up the wall eight or ten inches distant, and entered a crack in the ceiling. I supposed at the time that the spider had been injured in the scuffle, but what was my surprise after a few moments to see the spider coming back, and close behind another followed; the two went on the web near the centre, and stopped side by side, apparently consulting as to the best mode of attack. Then at the same instant both spiders darted upon the insect, one towards the head, the other towards the tail. So rapid were their movements I could hardly follow them. In a short time the insect was securely fastened. Both spiders then returned to the centre of the web. Soon after the friendly spider went to the crack in the ceiling, while the other enjoyed the feast alone. A. M.

North Manchester, Indiana, U.S., February 25

Diatoms in the London Clay

YOUR correspondent, Mr. W. H. Shrubsole, inquires where sections may be seen in the lower part of the London clay. He will find a good exposure in a brick-yard, half a mile south-west of Roydon Station on the Great Eastern Railway; in another at Hadham Ford, on the Buntingford branch line, and several in the brick-fields near Bishop Stortford. In all these sections the lowest part of the London clay may be seen, resting upon sands, or loams, of the Reading series. Upon direct application, or otherwise, I shall be happy to supply Mr. Shrubsole with further information. W. H. PENNING

Granville House, Finsbury Park, N.

VISUALISED NUMERALS

SINCE I addressed a preliminary memoir to you on this subject,[1] so much curious matter has reached me that I trust you will permit me to state my views afresh, and to deduce some inferences. Many of my readers do not and cannot visualise, and few have the habit in a pronounced degree. I must, however, beg them not to consider their own minds as identical with those of every other sane and healthy person. Psychologists ought to inquire into the mental habits of other men with as little prejudice as if they were inquiring into those of animals of different species to their own, and should be prepared to find much in many cases that is quite unlike their own personal experience.

Persons who have the tendency to use mental pictures as the symbols with which they carry on their processes of thought, do so especially in the case of numerals. Thus, when they think of "six," the figure "6" arises before the mind's eye more readily and vividly than the sound "six" echoes in their mind's ear, or than any other perception of that numeral manifests itself. Now the peculiarity that I accidentally found out is this, that about one out of every thirty males, or fifteen females, not only visualise their numerals in this way, but also invariably assign to each of them a definite place in their mental field of view, where it seems to have a home. Thus 6 may always lie low down to the left, 7 may be found a little higher and more to the front, and so on. It follows that whenever these persons think of a series of numbers, as 1, 2, 3, 4, 5, &c., they always appear to the mind's eye as ranged in a definite pattern or "form." This form is stated in all cases to have been in existence at the farthest period to which recollection goes back, though in many cases it has insensibly grown until it included the higher numbers and even negative values. It is usually of a rambling irregular shape, and though constant for the same person, it differs very greatly in different persons. It may consist of a row or rows of faintly marked figures, suspended in the air or lying on a hazy ground, and when the mental eye travels along the row, each as it is looked at in succession becomes for the moment vivid. Or it may consist of a faint line with nothing on it, along which the eye is wont to travel until it reaches the place where the figure it wants is known to reside, and then the figure starts into sight. Or it may be a haze penetrated by faint lines. Or there may be no figures at all in the line, but only dots denoting position. The planes on which the forms lie slope in some cases up to the heavens, in others down to an immeasurable abyss. They often start a little below the level of the eye and rise gently upwards, reminding one of what the appearance of objects on a table would be to a child whose head hardly overtopped it. All these forms can be drawn in a way more or less satisfactory to those who see them, and I have now received nearly eighty drawings, in about

[1] NATURE, vol. xxi. p. 252.

equal proportions from either sex. I exhibited copies of fifty-four of them (made by a camera lucida) at the Anthropological Institute on Tuesday, March 9, when I read a paper on the subject. The meeting was attended by several of my correspondents, who are well known in the scientific world, and who explained to the meeting their respective forms. They were Mr. George Bidder, Q.C., the Rev. G. Henslow, Mr. Roget, Mr. Schuster, F.R.S., Mr. B. Woodd Smith, and Col. Yule, C.B. Two of these, namely, Mr. Henslow and Mr. Schuster, see the forms objectively; they can point to the direction in which at any moment any particular figure appears to them to lie, and when they move their eyes the form moves too. In the other four cases the close co-ordination between brain and eye does not exist, and their images appear in a sort of dreamland having no strict relation with external space. The form of each observer is quite unserviceable to the rest, having no meaning except to himself.

The language employed by persons in respect to some of the features of these forms is apt to be very similar. Phrases are frequently met with, such as "Ever since childhood I have always seen . . ." "I cannot account for their origin in any way;" "It is perfectly independent of the will." I have verbally questioned a great many acquaintances whether they see numerals in any particular way. They usually say No; they ask what I mean, then profess inability to understand my object, and evidently think it some nonsensical fancy. But I get my reward in the proportion of cases I have mentioned. I have already become familiar with the quick look of intelligence on these occasions, and with the reply in words denoting that the right chord had been struck. Then the details are poured forth. I am frequently told how the habit used to be mentioned to relatives, but was ridiculed, and had ceased to be spoken about; or again, how some particular brother or sister had the same habit, but that one only, and so forth. The more I follow up the inquiries, the more the accuracy of the first replies becomes evident; thus, I ask for fresh sketches, and they correspond to the first. The general result is, that these statements bear all the marks one could expect of being the reports of what is clearly seen and what the writer is anxious to describe exactly. Among my foreign correspondents whose names are well known to the scientific world, and whom I am permitted to quote, are M. Antoine d'Abbadie, the traveller, and Member of the Institute, and Baron von Osten Sacken, the Russian entomologist.

Now for the results. These forms (as distinguished from the figures now seen upon them) are survivals of a very early mental stage, and must have originated before the child learnt his letters. There is no nursery book or diagram that could suggest their fantastic shapes. Their very variety shows them to be derived from no common origin. They frequently turn with a left-handed twist, which written and printed things do not. They are more archaic than the alphabetical and historical forms used by the same persons, for these bear evident marks of their origin. The clock face has little or nothing to do with them, for its influence can only be traced in three cases. I believe the forms to have been mnemonic diagrams, invented by the children when they were learning to count *verbally*, the *sounds* of the successive numerals being associated with the successive points of the form. Also, that when the children began to read, the visual symbols of the numerals quickly supplanted the verbal ones, and established themselves permanently in their place. On this supposition we possess in these numerical forms a representation of the route along which the attention naturally travels in the mental field of view of the child. It is entirely the child's own way of working, and therefore true to his nature; and being natural, it persists through life and offers itself in the adult for our examination.

The characteristic run of the lines in each form has some general similarity to that of the correspondent's hand-writing, but it must testify more directly to his mental peculiarities than the latter. The form shows the ways that the mind most likes to travel by, but the hand-writing is a compromise between what the writer desires to produce under the joint guidance of a natural fancy, of education and of fashion, with what the muscles of the hand can most easily effect. These forms or natural lines of thought are, I presume, analogous to those that instinctively prompt each species of animal to make his lair, burrow, nest, or other piece of domestic architecture, on an identical plan, with trifling individual variations, and that prompts gregarious animals to group themselves always in the same sort of array. In these numerical forms we find real "psychograms."

One of the most obvious facts common to them is the curious proof they afford of the perplexity caused by our barbarous nomenclature of the numerals. We *say* "ten," "eleven," "fifteen," &c., when we *see* "one-nought," "one-one," "one-five," &c., and other civilised nations are as bad or worse than ourselves, as the French with their "soixante quinze." The way in which the perplexity is shown is by the wriggles and twists in the forms at 10 and 12 and by the exceptional length of the 'teens. It is not easy to describe in a few words what is so variously pourtrayed, but the general effect on looking at my collection is most striking. It is really painful to think of the vast amount of petty difficulty to the existence of which this indisputable testimony is given. The difficulty does not cease with childhood, else the twists would have been smoothed away, and I am sure from trials on myself that I for my part still feel it much. I can dictate more easily by saying on-one, on-two, &c., and I can write and sum from dictation much more quickly when some such plan is used. It should be adopted by those who want to remove as much friction as possible from their brain-work. I have little doubt that the conflict between our language and our notation is a serious though unsuspected hindrance to the ready establishment of decimal weights and measures.

I find from inquiries made for me at schools that young people see forms more commonly than adults, but that their forms are less developed and sure. I conclude that where they are vivid and serviceable they are much used, and insensibly grow in vividness, in definition, and in automatic character. Otherwise they decay from disuse and become forgotten. Hence arises the rather sharp division between the seers and non-seers in adult life.

I am still desirous of more information on this subject, especially concerning children, and on colour associations with figures, letters, and words.

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THE TELEPHONIC EXCHANGE IN THE UNITED STATES

THE telephone has already become firmly established in America as a medium of daily communication. Eighty-five towns are thus connected, and to the various telephonic companies there are 70,000 subscribers, and the number is rapidly increasing. For some details as to the working of this method of intercommunication we are indebted to our French contemporary *La Nature*. If we enter the great hall of the central office of the Merchants' Telephone Exchange at 198, Broadway, New York (Fig. 1), we see a series of "Switchmen" engaged in establishing communications among the subscribers. There is a switchman corresponding with one of the subscribers who has called (Fig. 2); further on is another *employé* engaged in raising the notice signal. In the city, in the subscriber's house or office, is the office telephone, which is set up in a great number of houses; this model is very convenient for business, for it permits of speaking into the mouth-piece placed on the left, of

listening with the telephone, which is unhooked to apply to the ear, and at the same time of taking notes on the desk with the free hand.

The Broadway system of telephones belongs to the class of Pile Telephones, which allows these piles to be used to call the attention of the subscribers by means of ordinary bells, like the one in the desk, Fig. 4.

The transmitter is Edison's carbon telephone, based on the variations in electric resistance produced by variations of pressure which the plate exercises when we speak in front of the mouthpiece. The circuit is formed by the pile, two Leclanché elements, the transmitter, and a small Ruhmkorff coil. It constitutes the primary circuit of the coil. The line and the receiver of the other post are connected by the secondary wire of the bobbin, a wire whose other extremity is connected with the receiver of the post and with the earth. It follows that the line-currents are currents induced by the variations of activity of the current which traverses the primary wire of the coil. This arrangement has the effect of transforming into currents of tension the undulatory currents of the transmitter, of rendering them less sensible to the variations of resistance of the line, of facilitating the adjustment and suppressing a part of the commutators, the management of which might cause mistakes.

The receiver is a Phelps telephone, analogous to the Bell telephone, but the magnet of which is turned round in the form of a ring, which renders its management very easy (Fig. 4). In the position of repose or waiting, the telephone hangs on its hook, and by this fact alone, it comes into contact with a part forming a commutator, which suppresses all the telephonic part of the circuit, in order that the bell alone may intervene. Everything is thus ready for a call.

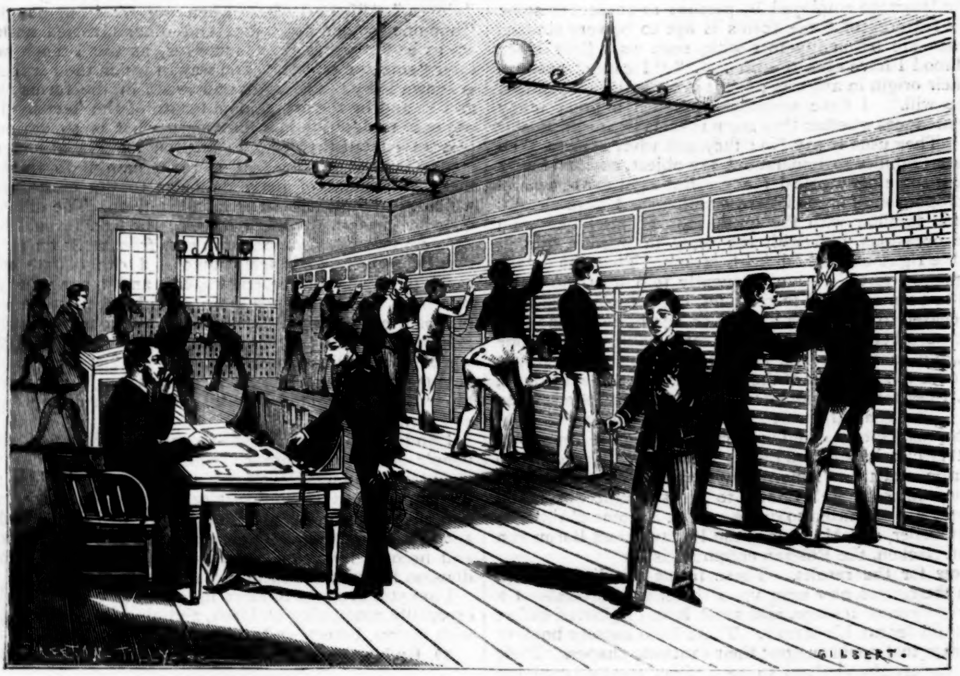

FIG. 1.—Interior view of the administration of the Merchants' Telephone Exchange, New York.

The telephones of the central post, speaker and receiver, are analogous to those of the subscribers; but to facilitate the management of these apparatus the speaker and receiver are mounted on the same steel stem, somewhat bent to serve as a handle, as in Fig. 2, and forms at the same time the magnet of the receiver. We may now follow all the series of operations. Suppose subscriber No. 731, whom we will call Edward, wishes to correspond with 511, whom we will call John. Edward begins by pressing on a small knob on the right side of the desk, Fig. 4. As the telephone is suspended it follows that in that position the current of Edward's pile traverses the line and a small electro-magnet in the central office; the electro-magnet, becoming active, detaches a small door (Fig. 2), which falls with a noise sufficient to call the attention of the *employé*, and exposes the number 731. The *employé* then places himself in communication with Edward, by placing the wire which corresponds to his telephone on a longitudinal copper bar also connected with Edward's line. The conversation then begins with the useful shout of hallo! hallo! Edward asks the *employé* to place him in communication with No. 511. If No. 511 is free at the moment the *employé* presses a knob after having connected the wire of No. 511 with the knob. The bell of John is set agoing, and when he himself is ready to correspond he presses the knob of his bell, which causes the door of his number to fall. By then placing a wire of communication directly between the two horizontal bars which correspond to the wires of Edward and John, direct communication between these two correspondents is established. If at this moment the *employé* is obliged to withdraw his telephone the communication between Edward and John is secret. If while these two are in conversation No. 42, James, wishes to correspond with John, for example, the *employé* may join in the conversation of the two interlocutors just like a servant announcing a visitor. If required, conversation may be established between the three subscribers. When

the conversation between Edward and John is ended, they each hang up their telephones and press upon the

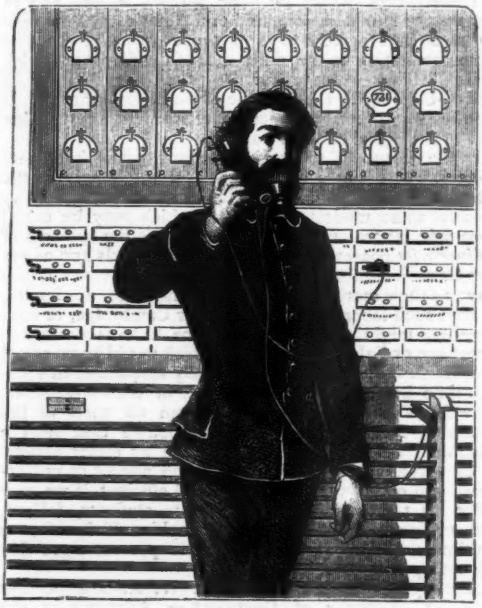

FIG. 2.—Switchman corresponding with a subscriber.

knobs, when the number of each is again exposed at the central post. The *employé* then knows that the conversation between the two subscribers is ended; he raises

FIG. 3.—Another *employé* raising the warning signal.

the door, suppresses communication between Edward and John, and all is ready for a new call.

In posts where there are 500 or 600 subscribers the numbers are arranged in order on tables containing each 500 to 100 doors; special arrangements are then employed to bring the series into communication with each other. At New York the central office makes not less than 6,000 communications daily, and everything is conducted to the complete satisfaction of the subscribers. The telephone has become for them as indispensable as the omnibus or hansom for London. Every month a list of subscribers is distributed from the central office. The Chicago list already forms a small volume. The Ameri-

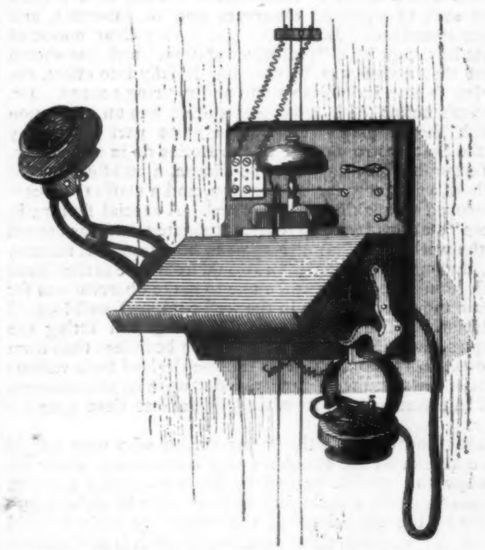

FIG. 4.—Telephone fitted up in a subscriber's office at New York.

can District Telegraph Company has greatly extended its services, and informs its subscribers that in three minutes after they call a liveried servant will be at their doors to distribute notes, circulars, &c., carry parcels, accompany a lady or a child to any place desired, or go for them, carry umbrellas to the children at school on a wet day, fetch the doctor, a cab, &c., &c., at any hour. We believe a beginning has been made in London of this invaluable means of communication; we trust that some arrangement will be come to with the Post Office authorities that will permit of its becoming universal. Its advantages are patent.

AN AMERICAN SEA-SIDE LABORATORY

THERE are some persons who, in their enthusiasm for doing a good thing, are led to mistake the name for the deed and to make as much fuss and general congratulation over an utterly inadequate representation of the good thing aimed at as would only be justified by the accomplishment of the good thing itself. One would have no special remark to offer on such curious self-deception, were it not that very frequently harm is done in connection with it in consequence of the enthusiastic individuals deceiving not only themselves but the public. Thus a worthy object is liable to be shelved or put aside from public attention on the ground that it has been accomplished, when really there has been only the most ridiculous pretence (consisting in the use of empty words), of attaining a long-desired and important end. Not only this, but such shams having once passed currently for the real things, the name of which has been

delusively assigned to them, and subsequently having proved to be failures and wind-bags, the real worthy object in the name of which they have been paraded, suffers. It is only too readily accepted by the unbelieving Philistine that such-and-such a scheme has been tried and has proved to be a failure, when in reality only a puffed-up substitute, and not the scheme in question, has ever had a chance.

The term "zoological station" is suggestive of these remarks. The term was introduced by Dr. Anton Dohrn when about to establish at Naples a large aquarium connected with a series of laboratories, worked by a permanent staff of scientific observers and of fishermen and other attendants. Dr. Dohrn had a very clear notion of what he meant by a "zoological station," and has shown what that notion was by carrying it fully into effect, devoting thereto indomitable will and untiring energy. Dr. Dohrn's notion of a zoological station was an institution which should play somewhat the same part in zoology as the State astronomical observatories do in astronomy. A favourable locality was to be chosen, a building erected with all appliances for observation, and a staff of workers employed in making observations. A special feature in these "stations" was, however, anticipated, and has proved in the working of that at Naples to be a practical feature, viz., that capable investigators would from time to time leave their home-avocations and come to make observations for a few months at a time in the well-equipped well-located "station." The total cost of erecting and fitting the Naples zoological station cannot have been less than from 12,000*l*. to 15,000*l*., whilst its income derived from various endowments and fees, and expended upon its maintenance and in the salaries of its officials is not less than 3,000*l*. a year.

That any enthusiastic young person who may unfold his umbrella on the sea-shore and contemplate under its shadow the starfish washed to his feet—should say that he has "opened a zoological station" may be strictly true so far as the etymology of the words "zoological" and "station" respectively is concerned; but it is at the same time a misleading announcement, and likely to do more harm than good to the cause of zoological stations.

There is no need to call a little sea-side laboratory by the pompous title which gains its connotation from Dr. Dohrn's magnificent institution on the Mediterranean shore, and it is a very satisfactory thing that such laboratories, open under certain conditions to naturalists who wish to make use of them, are coming into existence. At Concarneau, on the Brittany coast, the French Government had started a laboratory (under M. Coste) even before Dr. Dohrn's enterprise at Naples; M. de Lacaze Duthiers has since established a small laboratory at Roscoff, and the Austrian Government has constructed a laboratory and aquariums at Trieste which may one day rival those of Naples in extent and completeness.

Soon after Dr. Dohrn's institution had been set going, a liberal American offered to the late Prof. Agassiz the island of Pennikese as a site for a "zoological station." The attempt was forthwith made to make bricks without straw; a class of students were landed on Pennikese, and after a sort of holiday pic-nic of some weeks, returned home. No money was forthcoming to build the necessary laboratories and to maintain the necessary staff of scientific and other employés; so the Pennikese "station" was quietly and very wisely dropped. Mr. Alexander Agassiz has since constructed for himself (and described in NATURE) a private laboratory on the coast where he carries on his own admirable researches, and can receive three or four other naturalists, and give them working-room. This is no doubt the reasonable thing to do, supposing a limited sum of money is at command. It is of no use to proclaim in the absence of abundant straw that you are about to start a fine brick-field; you must either abandon the business altogether or be content to make a quiet little heap with the aid of what straw you have at command.

These things cannot be done without money, and at present the public in England and America will not subscribe so handsomely towards the erection of the first zoological station as they do to that of the fifty thousandth church. They were taught long ago to subscribe to church-building by the example of states and princes. It requires some such initiation to render the subscription lists of zoological stations popular.

In the absence of paternal governments and intelligent princes, where can zoologists look for the supply of the funds necessary to start zoological stations, necessary even for more modest institutions which may be called "sea-side laboratories"? Assuredly it is the business of *Universities* possessing some disposable funds and as yet free from the imbecility which Government commissions leave as their mark upon commission-ridden academies, to start such laboratories. Oxford or Cambridge, or both together, might support a very nice little laboratory at Guernsey, or Falmouth, or Arran, which would be managed by a resident director, and continually frequented in vacation time by the advanced students of the Universities, as well as by other naturalists from all parts of the country. It seems, however, improbable that such a laboratory will be *immediately* started by either Oxford or Cambridge. It is probable that the newest of universities, and one of the most active and efficient, if we may judge by the work produced by its students, fellows, and professors, viz., the Johns Hopkins University of Baltimore, U.S.A., will be the first to possess a sea-side laboratory of its own.

Already in the year 1878, Mr. W. K. Brooks, now assistant Professor of Comparative Anatomy in the University, was charged with the superintendence of a summer class in a temporary laboratory at Chesapeake. The scientific results of this session have been published by Mr. Brooks, and include some good observations by students of the University, besides his own—the more interesting notices relating to the development of Lingula and of Gastropod molluscs.

Last year Mr. Brooks was engaged on the study of the development of the oyster, and subsequently undertook again the direction of a temporary laboratory on the coast where work was done as yet unpublished. There is now a probability that the Chesapeake laboratory may be placed on a permanent footing, and it is, perhaps, pardonable for Transatlantic colleagues to express the opinion that such a step would be one of great and serious importance for the welfare of zoological study. It is quite evident that at Chesapeake there is access to a varied and abundant fauna, including some of the most interesting of marine forms, some not to be met with in European waters. It is also clear that there are capable students ready to avail themselves of the facilities of a laboratory, and energy and talent of the right kind to keep the institution at work. The spasmodic descent upon the sea-coast in a summer vacation, which is all that many a naturalist can, under present conditions, afford, is a very delightful thing, and may sometimes lead to the collection of a few new species of one group or another: but it is not in this way that the zoology of to-day can be forwarded. Protracted and minute study of the steps of development of all organisms is what is now necessary, and, similarly, careful observation at all times of the year of the habits and changes of adult forms. For this purpose a naturalist should be permanently (at any rate during a portion of his career) resident upon the coast. There is, further, a more obvious advantage and a very real one in the conditions of a permanent sea-side laboratory. The locality becomes *thoroughly well known* to the naturalists who frequent it; the accumulated knowledge is handed on from year to year, until at last what were regarded as

the rarest or most out-of-the-way animals can be fished up at five minutes' notice, and the time of appearance of this or that form, of the eggs of another, of the larvæ of another, is so precisely ascertained that the zoologist can go—not in his present hap-hazard fashion, to study anything which may turn up—but definitely primed and prepared to settle an important question in relation to a form which he is sure to obtain.

These advantages, and the honour of being the first University to possess a sea-side laboratory of its own, cannot be secured by the Johns Hopkins University without a certain definite outlay of money. What may be the cost of buildings and of permanently employing a fisherman, two attendants, and a scientific director in the United States, it is difficult to guess, but nothing less than an expenditure of 5,000*l.* on the building and an annual outlay of 700*l.* would give such an experiment a fair chance of success in this country.

E. RAY LANKESTER

THE SOLUBILITY OF GASES IN SOLIDS

MESSRS. HANNAY and Hogarth recently communicated to the Royal Society an important paper on the Solubility of Solids in Gases. The subject, an outline of which was given to our readers in an abstract of a preliminary paper by the same authors a few weeks ago, has attracted the more notice since it led Mr. Hannay to the research upon the artificial production of crystallised carbon, which is associated with his name.

The original purpose of Messrs. Hannay and Hogarth in undertaking this research was to investigate the condition of gases at their "critical point" with respect to their solvent power. For if at the critical point there really occurs a transition from liquid to gaseous state, and if the property of solids is one possessed by liquids alone, there ought to be precipitation of the dissolved solid matter as the substance passes through the critical point. If no such precipitation occurred, this would furnish an independent proof of the perfect continuity of the liquid and gaseous states, in addition to the proofs derived from the observed relations of temperature and pressure, and from the inability of optical tests to discriminate between gas and liquid in the condition of matter raised above its critical temperature.

A simple qualitative experiment was therefore undertaken as a preliminary test of the matter. "A solution of potassic iodide in alcohol was prepared, and a strong tube filled to about one-half with the solution. After sealing the tube was placed in an air-bath, and heat applied. No precipitation of solid could be seen even at a temperature of 350° C., more than 100° C. above the critical point of alcohol." A solution of resin in paraffin spirit showed no trace of decomposition at 360° C. under similar conditions.

To permit of experimenting under more exact conditions, a modification of Andrews's apparatus was devised, which, from its simplicity and efficiency deserves mention. A T-tube of wrought-iron of ½-inch internal and 1-inch external diameter was furnished with wrought-iron screw caps. Through one of these the pressure-screw works; through the opposite end the experimental tube is fixed. The side-branch, about 3 inches long, admitted an air-manometer. The apparatus, which was less than 12 inches in length, was filled with mercury. The device for packing consisted in the employment of stout india-rubber plugs. Where the pressure-screw passed through the rubber the latter was protected by a greased leather lining. When high pressures were employed the tube was cemented in with oxychloride of zinc. This extremely simple method of packing was so perfect as to give freedom of motion without leakage even at the enormous pressure of 880 atmospheres.

With this apparatus it was demonstrated that a clean crystal of potassic iodide dissolved gradually away in pure alcohol gas (the term *gas* referring, as Andrews suggested, to the fluid, at any temperature *above* its critical point). Bromide of potassium, and chloride of calcium were also found to be soluble in alcohol gas. Cobaltous chloride remained in solution at 320° C., and continued to exhibit its characteristic blue colour. It even showed a spectrum identical with that shown at 15° C. The spectrum of the acid decomposition product of chlorophyll similarly dissolved in alcohol, gives identical spectra at 350° C., and 15° C., though in air it decomposes below 200° C.

Other experiments with sulphur, selenium, and arsenic in bisulphide of carbon gave interesting but less conclusive results. The question whether the critical point of a gas is altered by having a solid dissolved in it appears to be affirmatively decided; for the authors found that while the critical point of pure alcohol is 234°·6 C. at a pressure of that of 65 atmospheres, alcohol containing potassic iodide was 237° at a pressure of 71·1 atmospheres.

Further attempts were made to obtain solutions of sodium in ammonia, gas, and hydrogen, in the latter case with partial success.

As a final conclusion the authors claim that these experiments, made at temperatures much further removed from the critical point than those from which Andrews reasoned, afford further proof of the perfect continuity of the liquid and gaseous states, and also complete proof of the solubility of solids in gases.

THE LATE MR. THOMAS BELL, F.R.S.

TO few men does English biological science owe more than to the veteran zoologist whose death we briefly recorded in NATURE, vol. xxi. p. 473. Born at Poole, in Dorsetshire, on October 11, 1792, Thomas Bell was educated as a surgeon-dentist, and on his establishment in practice in London he soon gained a high professional reputation. From an early period of life he devoted his leisure hours to zoological studies, and the fruits of his careful and conscientious labours are preserved in his numerous contributions to the *Transactions* and *Proceedings* of the Linnean, Geological, and Zoological Societies, and in his well-known manuals on "British Quadrupeds," "Reptiles," and "Stalk-eyed Crustacea." These latter formed part of the series of works published by Mr. Van Voorst, which have done so much to spread a knowledge of the natural history of our islands; and Mr. Bell was specially adapted to such a task, having a happy faculty of conveying scientific information in such a form as to be attractive to the general reader. A still more important undertaking was his illustrated folio, "Monograph of the Testudinata," begun in 1836, but unfortunately the publisher failed when only eight parts had appeared; the plates, along with some which had remained unpublished, were re-issued to the public in 1872 by Mr. Sothern, with letterpress by the late Dr. J. E. Gray.

But the services which Mr. Bell rendered to science were far from being confined to his published writings. From 1848 to 1853 he was one of the secretaries of the Royal Society, of which he had been elected a Fellow in 1828, and his business habits, energy, and personal popularity enabled him greatly to advance its interests. On his resigning this secretaryship in 1853 he was elected President of the Linnean Society, of which body he had been a member since 1815. Neither the scientific standing nor the financial position of the Society were then in a state at all worthy of its name and traditions, and the new President set vigorously to work at its reform. By personal example and influence in procuring suitable papers and in assuring good attendances, by an active enlistment of new members, and a rigorous supervision of expenditure, and by generous private donations to the

funds, Mr. Bell was completely successful in his object. Up to nearly the close of his long life he was in the habit of coming to town to attend the anniversary meetings of a society of which he may almost be called the second founder.

In 1866 Mr. Bell purchased The Wakes, Selborne, from the grand-nieces of Gilbert White, and the last twenty years were spent by him there in peaceful retirement, but not in idleness. Giving up systematic scientific work, as well as professional practice, he devoted the long evening of his life to observation in the field, especially of birds and plants, and to the reverent study of the life and labours of the famous historian of his adopted home. Only three years ago, at the age of eighty-five, he published an edition of the "Natural History of Selborne," which may safely be said to be by far the best of the numerous issues of that classic work.

In his Hampshire retreat, as in the heat and bustle of metropolitan life, Mr. Bell retained all the charm of manner and fine qualities both of heart and mind, which endeared him to all who had the privilege of knowing him; and up till very recently his robust health enabled him to bear the weight of years lightly as an honour rather than a burden. Under Gilbert White's roof-tree he died peacefully on Saturday, the 13th instant. By his death the scientific world seems to have lost one of its last links with a generation of good and faithful workers whose labours are too apt to be overlooked in the stir and struggle of controversies of the day.

NOTES

WE continue this week, by the courtesy of General Myer, our monthly series of Meteorological Charts for the Northern Hemisphere, compiled by the U.S. Signal Office. The present map shows the mean pressure, temperature, force, and direction of wind for June, 1878. To meteorologists the lessons of the chart will be plain; the next one which we issue we hope to accompany by an article explanatory of the purposes and utility of the whole series.

AFTER Easter the Royal Society is to meet at half-past four in the afternoon instead of half-past eight in the evening.

THE keepership of the mineralogical department of the British Museum has become vacant by the resignation of Prof. Story-Maskelyne, F.R.S., who is a candidate for the representation of Cricklade in the new Parliament.

THE work of casting the lenses of the great refracting telescope of the Paris Observatory has already begun at Feil's establishment. The founding of the flint disc has taken five days, and the annealing a full month. A like operation will soon take place for the Bishofsheim Observatory instrument.

THE *Melbourne Argus* says:—"The Count de Castelnau, for many years French Consul at Melbourne, died yesterday (February 4) at his residence, Apsley-place, East Melbourne. The deceased gentleman was an ardent student of natural history, and had pursued his studies in the various parts of the world whither his official duties led him. He was director of the Scientific Expedition sent by Louis Philippe, the King of the French, to South America, and was afterwards French Consul in divers parts of the southern hemisphere. While at the Cape of Good Hope he wrote a "Mémoire sur les Poissons de l'Afrique Australe." When he returned to Europe and began to put his voluminous notes in order, he made the disheartening discovery that while he had been temporarily disabled his servant had been for more than a month in the habit of using the sheets of paper on which he had bestowed so much time and labour to light the fires. He disposed of the remainder of his notes and drawings to Prof. Lacordaire, and about 1862 arrived in Melbourne, where he has since resided. Count Castelnau was an active member of the Zoological and Acclimatisation Society of Victoria. He contributed several valuable papers on the fishes of Australia, which have been published by the Society, and are recognised by naturalists as works of authority on the subject."

THE American Philosophical Society of Philadelphia, the oldest scientific society in America, celebrated the one hundredth anniversary of its incorporation by a public dinner at the St. George Hotel, on March 15. The Society was founded May 25, 1743, and incorporated March 15, 1780.

AN American correspondent writes that on March 30 and 31 the ninth annual meeting of the American Fish Cultural Association takes place. This association is by no means local in its character, but has extended fish culture all over the United States. It was through its exertions that the Government was induced to form the U.S. Fish Commission, with the secretary of the Smithsonian at its head. Among the members of the Association are found most of the leading icthyologists in the United States, with all of the Canadian officers who have Her Majesty's Provincial Fisheries under their charge.

A TELEPHONIC line has been formed between the meteorological station on the Pic du Midi and Bagnères-de-Bigorre (30 kilometres distance). General de Nansouty writes in high terms of the Edison telephone, which he is using.

THE Observatory at Mannheim has been removed to Karlsruhe.

THE Vesuvius railway from the observatory to the crater will be opened in April.

A CORRESPONDENT of *La Nature* sends that paper a photograph of a curious phenomenon met with in the cold of December last. It shows a bottle which contained a solution of nitrate of silver (1 per cent.). The cork is forced out and imprisoned at the extremity of a long cylinder of ice, due to increase of the volume of the mass in freezing. The bottle was also cracked, and several pieces detached.

THE cold room established by Tellier at the Conservatoire des Arts et Métiers for the fabrication of standard metres and kilogrammes on behalf of the several foreign governments in the international union, is not to be discontinued when the International Observatory at St. Cloud is finished. The apparatus will be sold to the French Government and used by it for the fabrication and comparison of standard kilograms and metres to be used in the several public conservatoires of France and the Colonies.

THE annual meeting of the West London Scientific Association was held on Tuesday, followed by a *soirée* and a varied and interesting exhibition.

THERE was a shock of earthquake on Monday at Poitiers and Chatellerault.

A NUMBER of pneumatic clocks have been installed by a Viennese speculator on the Paris Boulevards for the distribution of the time, in competition with the electric system advocated by Leverrier and now in course of experimentation. Three systems, Breguet's, Garnier's, and Rédier's, which have been successful in a first competition, are to be tested successively.

IT may be noted in confirmation of the theories advocated by Mr. Blandford in our last issue, that the period of north winds, clear skies, and high pressure set in in France in October 1878, and has continued without any long interruption up to the present moment. The date of the beginning of that remarkable period is almost the same as the end of the high-pressure period noted in India and the great Archipelago of Asia.

M. TIRARD, the French Minister of Agriculture, has directed the Prefects to report what kinds of fruit trees, pines, vines, and cereals suffered most and least from the December frost, in order that hints may be obtained for agriculturists, &c. The damage sustained by the Paris parks may be judged from the fact that in the Bois de Boulogne 54,000 evergreens, 20,000 firs, and 30,000 deciduous trees are required to fill up gaps, while in the Champs Elysées 3,200 trees were killed and 6,000 require cutting down to the roots. The total loss to the Municipality in the parks, avenues, and nurseries is calculated at a million francs.

As we stated last week, the council of magistrates of the city of Berlin had under consideration a few days ago a proposal, submitted by the firm of Siemens and Halske, for the construction of an electric railway across a portion of the capital. The line would start from the Belle Alliance-place, and run through Friedrich and Chaussée streets on to the Wedding-place. There will be two lines of rails, one for the up and the other for the down journey. The viaduct will be carried on iron pillars 14 feet 9 inches high, and nearly 33 feet apart. These pillars will be placed along the edge of the footpath, so as to cause the least possible interference with the ordinary traffic. The carriages will be narrow and short, containing ten sitting places and four standing places. The electro-dynamic machine which will propel the carriages will be placed under the floor of the carriage between the wheels, and a steam-engine of 60-horse power, which will be employed in the production of the electricity, will be placed at the terminus. The stoppages will be very few, and the rate of speed will be, it is expected, about twenty miles an hour. The chief object of the undertaking is to convey persons quickly across the city, and especially to facilitate access to the city line of railway.

AT a recent meeting of the Boston Society of Natural History, Mr. F. W. Putnam gave an account of his explorations of the ancient mounds and burial-places in the Cumberland Valley, Tennessee. The excavations had been carried on by himself, assisted by Mr. Edwin Curtiss for over two years, for the benefit of the Peabody Museum at Cambridge. During this time many mounds of various kinds had been thoroughly explored, and several thousand of the singular stone graves of the mound-builders of Tennessee had been carefully opened. The material obtained from the explorations is now arranged and on exhibition in the Peabody Museum. Mr. Putnam's remarks were illustrated by drawings of several hundred objects obtained from the graves and mounds, particularly to show the great variety of articles of pottery and several large and many unique forms of implements of chipped flint. He also exhibited and explained in detail a map of a walled town of this old nation. This town was situated on the Lindsley estate, in a bend of Spring Creek. The earth embankment, with its accompanying ditch, encircled an area of about twelve acres. Within this inclosure there was one large mound with a flat top, 15 feet high, 130 feet long, and 90 feet wide, which was found not to be a burial-mound. Another mound near the large one, about 50 feet in diameter and only a few feet high, contained sixty human skeletons, each in a carefully-made stone grave, the graves being arranged in two rows, forming the four sides of a square, and in three layers. From these graves many interesting articles were obtained. The most important discovery he made within the inclosure was that of finding the remains of the houses of the people who lived in this old town. Of them about seventy were traced out, and located on the map by Prof. Buchanan of Lebanon, who made the survey for Mr. Putnam. Under the floors of hard clay which was in places much burnt, Mr. Putnam found the graves of children. As only the bodies of adults had been placed in the one mound devoted to burial, and as nearly every site of a house he explored had from one to four graves of children under the clay floor, he was convinced that it was a regular custom to bury the children in that way. He also found that the children had been undoubtedly treated with affection, as in their small graves were found many of the best pieces of pottery he obtained, and also quantities of shell-beads, several large pearls, and many other objects which were probably the playthings of the little ones while living.

AT a subsequent meeting of the same Society, Mr. Putnam made a communication on the principles involved in the ornamentation of the pottery of some of the ancient nations of America, with particular reference to that from the Cumberland Valley in Tennessee, and from Nicaragua; illustrating his subject by a fine series of vessels of various shapes, selected from the Peabody Museum of American Archæology and Ethnology. After a general review of the methods of ornamentation employed by American nations of the past, he showed that, by a study of such large collections as those in the Peabody Museum, the artistic development of the ancient peoples of America was far greater than generally stated by writers; and that the art of ornamentation had, in many instances, risen above the simple patterns made by incised lines, rude stamps, and other early and crude forms. Both in colour and plastic work a realistic art had been produced which had often resulted in conventionalisms of great interest. He also stated that a study of this ancient pottery, with these principles of conventionalism borne in mind, would not only place some of these ancient American nations in a much higher artistic period than formerly supposed, but would also lead to the understanding of many of the singular ornaments on the ancient vessels, many of which, without this knowledge of the existence of realistic and conventional art, would be looked upon as crude and meaningless attempts at ornament, whereas, as he showed by several series of specimens, the simple knobs arranged symmetrically about a pot or water bottle, were instances of pure conventionalism from realistic forms, and prove that a comparatively high attainment in the decorative art had been reached. A proper and careful study of the principles involved by this interpretation of the artistic development of the ceramic art in America, he thought, would in time furnish means of making comparisons in regard to the probably connection of one ancient American nation with another, and also an understanding of many of the singular resemblances between widely separated peoples. Still, he said, the whole subject was yet in its infancy, and the connection of one ancient people with another in America can at present only be suggested from very unsatisfactory data.

THE following are among the papers to be read at the meetings of the Society of Arts after Easter, so far as the arrangements are yet complete:—April 2, "The Best Route for a Line of Railway to India," by B. Haughton, C.E. April 6, "Art in Japan," by C. Pfoundes. April 7, "Buildings for Secondary Educational Purposes," by E. C. Robins, F.S.A., F.R.I.B.A. April 8, "Recent Improvements in Benzine Colours," by F. J. Friswell, F.C.S. April 14, "The History of the Art of Bookbinding," by Henry B. Wheatley, F.S.A. April 16, "Russia's Influence over the Inhabitants of Central Asia during the last Ten Years," by Prof. Vambéry. April 21, "The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters," by W. Holman Hunt. April 22, "On Some Recent Advances in the Science of Photography," by Capt. Abney, R.E., F.R.S. April 27, "Iceland and Its Resources," by C. G. W. Lock. April 28, "Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes," by Thomas Fletcher. May 5, "The last Forty Years of Agricultural Experience," by John C. Morton. May 7, "The Present Condition and Prospects of Agriculture in South India," by W. Robertson, M.R.C.A.

May 13, "The Optical Properties of Crystals, and some of their Practical Applications," by Prof. W. G. Adams, F.R.S. The course of Cantor Lectures, which will be delivered during the same period, will be the third for the present session. It will consist of six lectures by Mr. R. W. Edis, F.S.A., on "Art Decoration and Furniture," to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

IN a report which he has addressed to the Department of Finance and Commerce at Calcutta, Mr. E. Colborne Baber, lately H.M.'s Consular representative at Chungking, furnishes some very interesting information respecting the western frontier of China, to one part of which, however, we can only allude. During his travels in the mountainous region west of Kiating-fu, in Szechuen, Mr. Baber discovered two kinds of tea of a very unexpected nature. In the monasteries on Mount Omi (or Ngomi) he was given an infusion of tea which is naturally sweet, tasting like coarse congou with a plentiful addition of brown sugar. It is only grown by the monks on the slopes of the mountain, and two days' further west its existence was unknown. The other variety, odd as it may appear, has a natural flavour of milk, or perhaps more exactly of butter. What is most interesting is the fact that it is wild tea, growing in its native elevated *habitat* without cultivation, and an unimpeachable instance of a wild tea-plant has, Mr. Baber affirms, never yet been adduced in China. This wild tea is found in the uninhabited wilderness west of Kiating and south of Yachow, at heights of 6,000 feet and upwards, and was described to Mr. Baber as a leafy shrub 15 feet high, with a stem some 4 inches thick. Every part of the plant, except the root, is used for making the infusion; the wood is chopped up and put into a kettle of water with the dried leaves and twigs, and being boiled yields a strongly coloured but weak tea, possessing a buttery flavour, which gives it some resemblance to the Thibetan preparation. Mr. Baber only found it in the Hwang-mu-chang plateau, a terrace perched among the stupendous gorges of the Tung river.

THE letter on the "Tay Bridge Storm," which appeared in NATURE, vol. xxi. p. 443, was written by the Hon. Ralph Abercromby, and not by Sir Ralph Abercromby, Bart., as erroneously stated.

THE additions to the Zoological Society's Gardens during the past week include a Grivet Monkey (*Cercopithecus griseo-viridis*) from North-East Africa, presented by Mr. W. C. Gordon; a Sykes's Monkey (*Cercopithecus albogularis*) from East Africa, presented by Mr. E. S. Savage; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, presented by Mrs. Ladell; two Spanish Ichneumons (*Herpestes widdringtoni*) from Andalusia, presented by Mr. J. C. Forster; a Caffer Wild Cat (*Felis caffra*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; three Impeyan Pheasants (*Lophophorus impeyanus*) from the Himalayas, a Square-spotted Snake (*Oxyrrhopus doliatus*) from South America, deposited; four Concave-casqued Hornbills (*Buceros bicornis*) from India, a Brazilian Cariama (*Cariama cristata*) from Brazil, two White-backed Trumpeters (*Psophia leucoptera*) from the Amazons, a Redshank (*Totanus caladris*), British, purchased; two Common Badgers (*Meles taxus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

SUSPECTED VARIABLE STARS.—Mr. Tebbutt, of Windsor, N.S.W., has drawn attention to the variability of the star B.A.C. 2472, which he appears to infer from its occurrence as a sixth magnitude in the occultation list of the *Nautical Almanac*, and his ineffectual attempt to observe its occultation on April 22, 1874, added to the circumstance of its present brightness not exceeding the eighth magnitude. But it seems probable that the supposed variability arises from an oversight of Taylor's in his observations either in 1834 or 1835. In vol. iii. of the Madras Observations it is certainly rated 6m., and Baily has followed Taylor in the British Association Catalogue, whence the *Nautical Almanac* estimate of magnitude was no doubt taken. Lalande, who observed the star twice, rated it 8 and 8½, D'Agelet, Piazzi, Bessel, and Argelander in the *Durchmusterung*, 8·0; so that observers, with the exception of Taylor, agree, and as he did not observe the star closely preceding on the parallel 65 Geminorum in 1834 or 1835, we may suspect that the magnitude of this star was inadvertently attributed to B.A.C. 2472, though his position undoubtedly refers to the latter star. Mr. Tebbutt also mentions that he has reason to think the neighbouring star, Lalande 14571, is variable; in this case there are not published data to guide us: it is 8½ in the "Histoire Céleste," 8 and 8·9 in Bessel, and 8·1 in the *Durchmusterung*.

THE SOUTHERN COMET.—Mr. Gill, in a letter dated—Royal Observatory, Cape of Good Hope, February 24, incloses an approximate orbit of the great southern comet, calculated by Mr. Finlay, the first assistant. The elements are as follows:—

Perihelion passage, January 27·55 G.M.T.

Longitude of perihelion	280 16
„ ascending node	123 24·5
Inclination	75 12
Logarithm of perihelion distance	7·90315

Motion—direct.

It will be remarked that this orbit is entirely different to that we published last week, which was deduced from the only positions available for the purpose—the very rough ones forwarded by Mr. Gill on February 17. From the same approximate data an orbit was also calculated at Lord Lindsay's observatory, with results almost identical with those in NATURE, but which were received too late for insertion last week. It is to be presumed that Mr. Finlay will have availed himself of the accurate places which were obtained at the Cape on February 11, 13, and 15, but so far as we know have not yet been transmitted to Europe; hence it may be anticipated that his elements will prove to be the true ones, and we shall have, in the case of this comet, a similar one to that of the comet of 1533, for which two orbits by Douwes and Olbers, bearing no resemblance, appear in our catalogues, having been deduced from rough observations extending over a limited period. We have already had occasion to point out in this column that the comet of 1686 presents a similar difficulty if only the European observations are employed, but the correct orbit is assigned when we introduce in the computations the positions observed at Amboyna and in Siam.

Calculating from Mr. Finlay's elements, we have the following places of the comet for 8h. Greenwich M.T.

	R.A. h. m.	N.P.D. ° ′	Log. distance from Earth.	Log. distance from Sun.
March 27	5 7·9	96 20	0·2347	0·2237
28	5 10·1	96 3		
29	5 12·2	95 47	0·2492	0·2334
30	5 14·3	95 31		
31	5 16·4	95 16	0·2633	0·2427
April 1	5 18·4	95 1		
2	5 20·4	94 47	0·2769	0·2516

It is right to state, that from the greatly diminished intensity of light which the comet is likely to present at this time, Mr. Finlay doubted if it would be possible to observe it in Europe, and Mr. Gill adds that in strong moonlight on February 23 he failed to discover the least trace of it, and was not sanguine with his optical means that he would see it again. Nevertheless as instruments of much greater capability can be brought to bear upon a search for the comet in these latitudes, the above places may be found of service.

We are indebted to correspondents in Australia, Tasmania, and South America for various notices of this fine comet, chiefly extracted from the public journals. The *Launceston Examiner* of February 3 states that attention had been called the previous evening to what appeared to be the tail of a very large comet, which "extended from thirty to forty degrees above the horizon, and was setting almost in a line with the sun, which prevented the nucleus and brighter part of the tail being seen earlier;" it is added, "if it were now winter instead of summer it would present a glorious spectacle about dark." At Melbourne the tail was seen on February 2 soon after sunset, but the nucleus had not been visible at the Observatory up to February 5; no doubt Mr. Ellery will give a good account of it later, and should nothing prevent the great reflector from being brought to bear

upon the comet, observations of much value may be received from Melbourne.

Mr. E. A. Fry, writing from Birmingham, incloses an extract from the *Anglo-Brazilian Times* of February 24, wherein M. Liais publishes the rough approximation to the elements, which the Emperor of Brazil telegraphed to the Academy of Sciences at Paris. M. Liais states that he had combined the two directions observed at Rio on the 4th and 8th inst. with the information in relation to the appearances observed at other places to arrive at some indication of the nature of the orbit, and with such meagre data it is not surprising that his figures should differ so greatly from Mr. Finlay's. He suggests that the object which several American astronomers mention having remarked during the totality of the solar eclipse of January 11 in California, which was "distinct from the fixed stars and planets," and conjectured to be an intra-Mercurial body, "may have been this comet:" not a very happy suggestion if we are to rely upon Mr. Finlay's elements, since at the time in question the comet would have been situated 22° west and 23° south of the sun.

Other notices received describe the brilliant appearance of the tail in the first week of February, but supply no particulars with reference to the position of the nucleus.

METEOROLOGICAL NOTES

THE storm of December 28, 1879, will long stand out among British storms, not only as having occasioned the fall of the Tay Bridge, but also as having presented peculiarities which, taken together, are, so far as observation goes, unprecedented in these islands. Some of the more important of these peculiarities were brought before the meeting of the Scottish Meteorological Society on March 10 by Mr. Buchan. Of these the most remarkable were the barometrical fluctuations, which were quite extraordinary along the central path of the storm from Barra Head to Wick. The barometric readings at Dhu Heartach Lighthouse, twelve miles south-west of Iona, reduced to 32° and sea-level, were, in inches, 29·615 at 10 A.M., 29·405 at noon, 29·205 at 1·30 P.M., 28·905 at 4 P.M., 28·705 at 5·5 P.M., 28·645 at 6 P.M., 29·105 at 7 P.M., and 29·342 at 9 P.M. Thus in one hour, from 6 to 7 P.M., the barometer rose 0·460 inch, or nearly half an inch. That this extraordinary fluctuation was no isolated phenomenon is shown by what was noted at the other lighthouses in the vicinity. Thus the barometer rose, from 4 to 9 P.M., 0·790 inch at Barra Head, from 5 to 9 P.M., 0·681 inch at Monach, 0·760 inch at Ushenish, and 0·660 at Skerryvore; from 5.30 to 9 P.M., 0·700 inch at the Point of Ardnamurchan; and from 6.15 to 9 P.M., 0·590 inch at Kyleakin. To north and south of the central path of the storm the fluctuations, though unusually large, fell far short of these amounts. From the observations made at the numerous stations of the Society, including the sixty Scottish lighthouses, the position of the centre of the storm could be determined with a close approximation to exactness hour by hour. From the results it is shown that the cyclone travelled onwards in each of the five hours respectively from 4 to 9 P.M., 30, 45, 53, 70, and 70 statute miles, the rate of progress from 7 to 9 P.M. being thus about $3\frac{1}{2}$ times the average rate in this part of Europe. The behaviour of the temperature of the air was equally striking, rising everywhere to from 52° to 57° as the centre of the cyclone advanced, and falling after it had passed. In other words, the temperature rose on this occasion to the average of the first week of June. From data supplied by Mr. Scott, of the Meteorological Office, the maximum velocity of the wind during the heaviest gusts was at the rate of 96 miles an hour at Aberdeen, 120 miles at Glasgow, and probably 150 miles at Seaham. Had pressure anemometers been pretty generally in action over Scotland on that evening, much higher wind-forces than these would doubtless have been recorded. The force of the wind was comparatively little felt to the north of the central path of the cyclone, owing to the low gradients in that direction, no notice of a storm being recorded, for example, at Cape Wrath, Stourhead, or the Butt of Lewis; but in the path of the centre and for some distance to southward, the storm swept onwards with destructive and uncontrolled fury, raising the spray in what seemed solid masses of water against the lantern of the Dhu Heartach Lighthouse, 145 feet high, which struck the glass with a sound like that of road metal, and completely overturning whole forests of Scotch firs 200 years old, so that not a single tree was left standing, and where the trees were fast rooted in the rock prostrating them along the ground after forming a joint near the roots by splintering this part of their trunks to a bundle of matches. The steepest gradient afforded by the barometric observations which were made is about 1 inch to 110 miles. Steeper gradients were noted during the great Edinburgh hurricane of January 24, 1868, when a gradient of 1 inch to 72 miles occurred, and in accordance therewith an amount of damage was done to structures of solid masonry of which the storm of December last affords no parallel

MR. CHARLES CARPMAEL, who has recently been appointed Superintendent of the Meteorological Service of the Dominion of Canada, has issued the first number of a *Monthly Weather Review*, presenting with fairly satisfactory fulness the weather and other meteorological phenomena of the Dominion for January, 1880. The storms which in any way affected Canada during the month are detailed, and their tracks indicated. Weather-probabilities are issued by the office in Toronto at 10 A.M. daily, and posted up at 350 places in Canada within an hour from the date of issue. From an analysis of the successes and non-successes of the weather-probabilities of the month given in the *Review*, it would appear that $80\frac{1}{2}$ per cent. were fully verified, $93\frac{1}{2}$ per cent. either fully or partly verified, leaving only $6\frac{1}{2}$ per cent. of failures. The outstanding features of the meteorology of the month were the low mean pressure in the west, the high pressure in the east, and the very high temperature which prevailed at all the stations. The mean temperature for January, 1880, was the highest yet recorded in any year at Toronto, thus offering a striking contrast to the weather which prevailed generally over Europe during the month. This meteorological service is under the deepest obligations to Prof. Kingston, through whose exertions chiefly it was called into existence. These arduous exertions have told seriously on his health, and he has been obliged to retire from the position of superintendent. He carries with him the best wishes of meteorologists coupled with a hope that in his retirement he will be able to continue his services in the furtherance of American meteorology.

IN a twelfth contribution to meteorology, Prof. Loomis presents us with isobars for the United States, showing for January and July the mean pressure of the atmosphere from the observations made by the Signal Service of the War Department for the six years ending June, 1877. In July pressure is highest in Florida, being 30·100 inches, from which it diminishes on advancing into the interior to 29·850 inches in Utah, rising again on proceeding west to about 30·100 inches on the Pacific coast, in latitude 45°. This state of things is, roughly speaking, reversed in January, with, however, several noteworthy differences. The highest pressure, 30·250 inches, is now in Utah, and the lowest generally round the coasts, falling to the minimum, 30·000 inches, at the entrance to Fundy Bay. The high pressure of the interior may be regarded as spreading over the States occupying the region from Minnesota to California. The slight break in it on the chart, as occurring about Cheyenne, will require confirmation from future observations. A second area of high pressure spreads over the larger portion of the south-eastern and Southern States. These two distinct areas of high pressure are separated from each other by a region of lower pressure stretching in a south-west direction from Chicago, towards the Rocky Mountains. The discovery of this peculiarity in the winter-distribution of pressure in the States which, correctly we think, is ascribed to the path usually taken by the barometric minima of American storms in the earlier part of their course, constitutes, perhaps, the most valuable contribution to meteorology yet made by Prof. Loomis.

PROF. LOOMIS institutes an interesting comparison of the varying rates of progress of storm-centres, and shows that over the United States the rate of progress is twenty-six miles an hour, whereas, over the Atlantic, it is only fourteen miles, and on the continent of Europe, as shown by Dr. Neumayer, it does not exceed sixteen miles an hour. In this connection it is pointed out that the winds on the Atlantic are stronger than they are over either of the continents, and the winds of central Europe are stronger than the winds of the United States, relations that suggest whether friction may not be concerned in determining the rate of the onward progress of storms. As bearing, however, more immediately on this question, Prof. Loomis draws attention to this important distinction between American and European storms, viz., from the Rocky Mountains to the Atlantic Ocean storms advance from a drier to a more humid atmosphere, whereas in Europe, while storms pursue their easterly course, they proceed from a humid to a drier atmo-

sphere. An examination of the rate of progress of storms in north-western Europe, as compared with the rate in the interior of the continent, would contribute important data to the inquiry here raised.

PHYSICAL NOTES

ACCORDING to a theory of crystallogenesis recently brought before the Bologna Academy by Signor Marangoni, the formation of crystals is due to composition of molecular vibrations. As vibrating plates give the symmetrical nodal lines of Chladni, so solid bodies, in their vibrations in three directions, produce nodal surfaces, which correspond to the cleavage surfaces of crystals. The author (confining himself to simple substances) considers a chemical molecule as one produced in general by union of two atoms rotating round one another; a physical, as arising from two chemical rotating round one another. If these motions do not occur in the same plane, we have motions of a pendular nature in the three directions of space. Where the times of vibration are in simple ratios to each other, crystals are formed; where, again, the relations are complicated or incommensurable, we have liquids; and in the gaseous state, the physical molecules break up into the chemical. If the ratios of the three motions are 1 : 1 : 2 we have 4 osculating planes, enclosing a tetrahedron. The common orientation of these planes in all molecules produces planes of cleavage. If the ratios are 1 : 1 : 3, there are 6 osculating planes and a rhombohedron. By means of a tuning-fork throwing a soap-bubble into vibration, the author illustrates his hypothesis. He deduces a number of crystallographic properties, further assuming that parallel-directed vibrations attract each other, while opposite repel.

A SERIES of experiments in spectrum-analytical comparison of gas, sun, day, and the electric light has been lately made by Herr Meyer (Carl's *Zeitsch. für angew. Electr.-Lehre*, 1, p. 320, 1879). He used both Vierordt's method and a method first suggested by Bohn; in the latter a Nicol prism is fixed before one-half of a slit and receives the light from one source; behind it is the Nicol, rotatable in a graduated circle of Wild's polaristrobometer. The light beam passing through both prisms strikes a rectangular glass prism, which reflects it into the spectrum apparatus. The second slit-half is illuminated either directly or through a second rectangular prism from the second light source. The numbers show that the brightness of the colours in the gas-spectrum, compared with that in sun or daylight and the electric light, steadily decreases from the red to the violet end of the spectrum. As sunlight is considerably brighter in the middle parts of the spectrum than the electric light, the latter should appear yellow with the former; and in a Ritchie photometer the surface illuminated by the electric light did indeed appear yellow like an orange, in comparison with that illuminated by the sun. Another interesting fact elicited is that in daylight there is comparatively more red and yellow, and less blue and violet light than in sunlight.

LAST year M. Van Rysselberghe devised a regulator rigorously isochronous in theory, that is, the movable masses of which were displaced exactly along a parabola. It was considered, however (in the Belgian Academy), that practically the number of articulations was too great to allow of the isochronism being realised. M. Van Rysselberghe has now hit upon a different and very simple combination, in which the articulations are reduced to a minimum, and which gives a very close approximation to the parabola, though not that figure rigorously. He has a model, the velocity of which is maintained constant to nearly $\frac{1}{1000}$, while the force transmitted to the vanes and absorbed by them, varies in the ratio of 1 to 200. He does not despair of pushing the precision to $\frac{1}{100000}$ (or less than a second a day). One special feature in the apparatus is a system of vanes designed to increase the resistance in a proportion slightly greater than that furnished by the increasing aperture of the moderator-lozenge. These vanes, on a straight horizontal axis, strike the air at different inclinations according to the resistance to be developed, being moved by suitable gearing, and automatically into various positions from the horizontal to the vertical. There is also a system of compensation for variations of temperature. This regulator is expected to be of great service in application to registering at a distance, to chromographs, to equatorial telescopes, to siderostats, to telegraphs, and to industrial motors. (It is described in the *Bulletin* of the Belgian Academy, No. 1, 1880.)

SOME experiments by Herr Reusch, with a view to determining the modulus of elasticity of ice, have been recently published (*Ann. der Phys.*, No. 2). Rectangular prismatic lamellæ of ice were obtained by pressing the edges of two heated plates of zinc, fixed parallel in a frame, into plates of ice, the ends being then cut with two other zinc plates in the frame. After careful measurement and weighing, the number of transverse vibrations of the tone given by the lamella supported near the outer fifth was determined by means of a Marloye sonometer (a monochord 1 m. long, with tuning-fork giving 256 vibrations per second). This was done, of course, in a room with the temperature below zero. Calculating according to the formula given by Seebeck, Herr Reusch found the arithmetic mean (from five experiments) of the modulus of elasticity E, in kilogrammes per square millimetre = 236·324. The only previous determination known to him is that of Frankenheim (in Mousson's "Physics"), where E = 541, a number which he therefore thinks more than twice too great.

IN a recent paper in the *Annalen der Physik* (No. 2), Herr Fröhlich endeavours to prove that of the three electrodynamic fundamental laws enunciated by Clausius, Riemann, and Weber severally, as satisfying the principle of conservation of energy, that of Clausius—and, supposing unequal velocity of the two electricities in the galvanic current, the two others also—leads to theoretically unreliable and practically useless results.

GEOGRAPHICAL NOTES

LETTERS have been received from Prof. J. B. Balfour, announcing that he had been safely landed by H.M.S. *Seagull* in Golbourn Bay, at the west end of Socotra, on February 11, weather not permitting the vessel to go round to the principal port, Samarida. Prof. Balfour had formed pretty high expectations of the island from what he had heard, but these were greatly exceeded by the reality. The flora was found to be rich and varied, and 150 species of plants, some of great interest, had been obtained in a few days. Birds were numerous, as also reptiles and insects. There was plenty of water, and some splendid *Dytisci*. The geology was very perplexing, granite, limestone, and dioritic rocks being mixed up in an extraordinary manner.

WE are glad to see that the Geographical Society is doing its best to show honour to Prof. Nordenskjöld and to give him a hearty welcome to this country. A distinguished deputation awaited his arrival at Portsmouth on Monday, but unfortunately the *Vega* did not appear, though by this time she has, most probably, arrived. The highest British mark of honour awaits the explorer—a dinner at Willis's Rooms, at which, we are glad to learn, the Prince of Wales will be present. We have said so much concerning the work of Prof. Nordenskjöld that scarcely anything new is left to say either concerning himself or concerning his services to science in the voyage he has so successfully accomplished. Commerce is sure to follow up the pioneer work of the *Vega*, and we hope that very soon the region explored will be garrisoned, as the *Times* puts it, by meteorologists who will "watch the winds where they are born."

AT the meeting of the Geographical Society on Monday evening it was announced that Prof. Nordenskjöld, who is already a Gold Medallist, had been elected an Honorary Corresponding Member. Mr. E. Hutchinson afterwards read a paper on the ascent of the Binué branch of the Niger in 1879 by Ashcroft, an agent of the Church Missionary Society, in the little steamer *Henry Venn*. The party left Lokoja, at the confluence with the main river, on July 8, and on August 28 arrived opposite Yola in N. lat. 9° 16′ and E. long. 12° 31′, some 364 miles to the eastward in a straight line. From Yola they proceeded past the junction of the Faro tributary, where Dr. Barth crossed in 1851, and for about forty miles higher up, anchoring on September 4 off the town of Garawa, which lies some distance from the river bank. This place is situated in N. lat. 9° 28′ 45″ and E. long. 13° 26′. As the river was falling fast, Mr. Ashcroft only ventured to go a few miles further up in a steam launch. The distance traversed by the *Henry Venn* Expedition, which had never been previously explored, is probably not far short of 150 miles, and of this an exceedingly good chart has been made by Mr. Flegel, a German who, in his anxiety to join in the exploration, accompanied the party as ship's clerk. It is satisfactory to learn that the natives, except at one spot, showed themselves particularly well-disposed.

Mr. Hutchinson also made some interesting remarks, partly of a speculative nature, on the river systems of the Binué and the Shari, and their possible connection near Lake Chad.

MR. J. W. MOIR, of the Central Africa Trading Company, has just sent home from Livingstonia some notes of an expedition from the Mombera country, near the northern end of Lake Nyassa, to the north-west portion of the great basin of the Loangwa, which falls into the Zambesi at Zumbo, above the Kebrabasa rapids. Crossing the Kasitu river he marched a little north of west through an uninhabited, undulating forest-land, scantily supplied with water. No game was seen, but the *tsetse* fly was very abundant in several swampy valleys. Mr. Moir then crossed the Rukuru river, and after a march of twenty miles further west and north-west, passed over a low sandy watershed into the Loangwa basin. The country was that of the Basenga, whose chief village is in the bend of a very small stream which flows at the bottom of a deep broad course, probably well filled in the rainy season by the neighbouring Palaosenga hills. In this part water was very seldom to be had, except by digging in the watercourses, but the soil appeared fertile. Mr. Moir was able to get very little information about the surrounding country, as the people professed that they had never dared to leave their villages owing to their dread of the Mangoni. On the return journey the party passed through an uninhabited tract, chiefly covered with rather scrubby forest, to the Mombero country. In the Basenga country the first chief met with was Tembwe, who, it is interesting to note, saw Livingstone, probably in 1863, in the Tumbuka country further to the south; he has a large village, and there are generally some Arabs there. The principal chief of the Basenga, Kambombo, lives at the first-mentioned village, which is strongly stockaded. Here an Arab caravan had settled down for a time, having come from Zanzibar *viâ* Ujiji.

WE regret to learn that fears are entertained in St. Petersburg of the safety of Col. Prejevalsky, who at the last news was attempting to make his way into Thibet from China. It is stated that the German embassy at Pekin has received a letter from Count Szecheny, who was following the Russian expedition, saying he intended to return, not wishing to share the same fate as befel Col. Prejevalsky, whatever that may be. Disquieting rumours also come from Russian Turkestan as to the traveller's safety. One guide returning from Chardini reports that while he was searching for a road that had been lost, Prejevalsky and his comrades disappeared, and he was obliged to turn back. We earnestly hope these rumours may turn out to be unfounded; Col. Prejevalsky's loss would be a severe one to scientific exploration.

TWO Austrian travellers, the *Times* Calcutta correspondent telegraphs, March 21, have arrived at Rangoon from China by the overland route through Yunnan and Bhamo. They attempted to enter Thibet, but were prevented by Chinese officials. No doubt this is the party of Count Szecheny referred to above.

IN its last summary of colonial intelligence the *Colonies and India* furnishes a curious piece of news from New South Wales, which recalls to memory a sad incident in Australian exploration. A few years ago, we are told, a man named Hume, who had penetrated very far into the interior, stated that there was a white man living with the blacks in the far west, who, he was confident, was a survivor of Leichhardt's expedition. This assertion was at the time mostly disbelieved, but information has now been received which leads to the impression that Hume's statement was true, and that the white man in question died about November, 1876, when making an attempt to leave the black tribe with which he had been living, and to reach the camp of some white explorers.

FROM the Hongkong papers we learn that Commander Salmond, in H.M.'s Gunboat *Midge*, has recently paid a visit to Sandakan Bay, in Northern Borneo, where he found Mr. Pryor, the agent of the English Association, holding, as we have before recorded, a large concession from the Sultan, diligently prosecuting his work of inquiring into the resources of the country. The natives are reported to be quite content with his system of administration.

THE current number of *Les Missions Catholiques* contains the first instalment of Père Janvier Martini's account of his journey from Khartûm to Gardaref, as well as much information respecting the late Abbé Debaize, who died at Ujiji on December 12. Under the title of "Captivité et Deliverance," Père Deguette also commences the narrative of his misfortunes in Corea.

THE *Presse* of Vienna announces that Capt. Weyprecht is making, in conjunction with Count Wilczek, the final arrangements for a new Polar expedition. Many Dalmatian sailors have already offered to take part in the expedition. Count Wilczek and Capt. Weyprecht will shortly visit Hamburg to confer with representatives of various European Societies.

ACCORDING to the *Times* Candahar correspondent Mr. Giesbach, geologist, has, at the Sirdar's special request, been appointed by the Indian Government to report on the mineral capabilities of the Candahar district. Major Leach, R.E., has also been specially deputed for survey purposes in that district under Col. St. John's orders.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The number of failures to pass the Local Examinations continues very large; possibly this may be traced to defective teaching of science subjects, and the relation of the elements of the theoretical to the concrete aspects of geometry and physics. Four senior girls and twenty three senior boys obtained a first class. None of the former are distinguished in the physical science subjects. Thirty-six junior girls and 215 junior boys obtain a first class. More than one-third of these junior girls have distinguished themselves in one or more subjects of physical science.

PROFESSORS PAGET, Stokes, Liveing, C. C. Babington, and Dewar will lecture in the coming term; also Mr. W. J. Sell (Chemistry), Mr. Sedgwick (Demonstrations in Mammalia).

SOME new cases for the Bird Room, and apparatus for the Chemical Laboratories has been voted.

THE late Dr. Andrew Vans Dunlop of Edinburgh has left the University of that City the residue of his estate, amounting to about 50,000*l*. Of this sum, 30,000*l*. will, it is understood, be paid to the University authorities; while the remaining 20,000*l*. will ultimately accrue to the Uuiversity. 3,000*l*. is to be added to the general fund of the University; and the remainder of the 50,000*l*. is to be employed in founding sixteen "Vans Dunlop Scholarships," of the annual value of 100*l*. each, tenable for three years. It is also provided by the will that the first six scholarships created shall be for students of medicine, while the others are to be equally divided amongst students of the classes of chemistry, English literature, classics, political economy, logic and moral philosophy, natural philosophy, mathematics, natural history and engineering.

SCIENTIFIC SERIALS

THE *Proceedings of the Linnæan Society of New South Wales*, vol. iv., parts 1 and 2 (Sydney, 1879).—Part 1. Rev. J. E. T. Woods, on some tertiary fossils; describes a large number of fossil shells from the tertiary (probably miocene) beds of Muddy Creek, Western Victoria; figures of all the species are given. On some new marine shells from Port Jackson (three new species described and figured). On some freshwater shells from New Guinea (three new species of Melania, with figures).—On some new marine shells from Moreton Bay (three new species). On *Arauja albens* (notice of its appearance at Moreton Bay).—F. M. Bailey, on some of the introduced plants of Queensland. On a new species of Asplenium from Trinity Bay Range.—W. A. Haswell, M.A., on the Australian species of Penæus (six species described as new). A contribution to a monograph of the Australian Leucosiidæ; adds twelve new species to the list of Australian forms, *i.e.*, four new species of Leucosia, two of Myra, one of Myrodes, three of Phlyxia, one of Lithadia, one of Arcania, nearly all of which are figured.—Wm. Macleay, on some fishes from the Solomon Islands; gives a list of fifteen species, not one of which is mentioned in the fishes of this group as given in the "Voyage of the *Curaçoa*," and describes a new species of Mesoprion.—E. P. Ramsay, on the zoology of the Solomon Islands (enumerates forty-five species of birds). Contributions to the zoology of New Guinea; parts iv. and v. On Mr. Goldie's collections, with a list showing the distribution of the species of birds.—N. de Miklucho-Maclay, the proposed zoological station at Sydney.—E. Meyrick, on a micro-lepidopteron destructive to the potato (*Lita solanella*).—Dr. Cox, on two new species of Helix from the Louisiade group.—Part 2.

Rev. J. E. T. Woods, on the relations of the Brisbane flora; and, with the assistance of F. M. Bailey, a census of the flora of Brisbane, including the plants of Moreton Island and the country within twenty-five miles of the city of Brisbane; the total number of species enumerated is 1,228.—E. Meyrick, descriptions of Australian micro-lepidoptera. Part 2. Crambites. —James Hobson, notes on *Cypræa guttata*; gives as the habitat of this extremely rare shell, New Britain, but few particulars are given.

Journal de Physique, February.—On the determination of the elements of a vibratory movement, by E. Mercadier.—On the law of the thermal capacities of gases, by N. Slonginoff.—Atmospheric polarisation and influence of the terrestrial magnetism on the atmosphere, by H. Becquerel.—On the differential equation $\frac{d^2u}{dt^2} = a^2\frac{d^2x}{dt^2}$, which leads to the theoretic expression of the velocity of sound, by M. Amagat.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 18.—"On the Structure of the Immature Ovarian Ovum in the Common Fowl and in the Rabbit. To which is appended some Observations upon the Mode of Formation of the *Discus proligerus* in the Rabbit, and of the Ovarial Glands or 'Egg-tubes' in the Dog." By E. A. Schäfer, F.R.S.

"On the Modifications of the Spectrum of Potassium which are Effected by the Presence of Phosphoric Acid, and on the Inorganic Bases and Salts which are found in combination with Educts of the Brain." By J. L. W. Thudichum, M.D., F.R.C.P.L. Communicated by John Simon, C.B., F.R.S.

"Researches into the Colouring Matters of Human Urine, with an Account of the Separation of Urobilin." By C. A. MacMunn, B.A., M.D. Communicated by A. Gamgee, M.D., F.R.S., Brackenbury Professor of Practical Physiology and Histology in Owens College, Manchester.

"On the Coalescence of Amœboid Cells into Plasmodia, and on the so-called Coagulation of Invertebrate Fluids." By P. Geddes. Communicated by Prof. Burdon Sanderson, LL.D., F.R.S.

Zoological Society, March 16, Dr. A. Günther, F.R.S., vice-president, in the chair.—Mr. W. K. Parker, F.R.S., exhibited and made remarks on the eggs and embryos of some crocodiles (*Crocodilus palustris*), obtained in Ceylon by Dr. W. R. Kynsey, Principal Medical Officer of Colombo.—Mr. W. A. Forbes read a paper on some points in the anatomy of the Sumatran rhinoceros.—Mr. Edward R. Alston exhibited and made remarks on a coloured drawing of an adolescent specimen of *Tapirus dowi*, now in the Paris Museum.—Mr. Alston also exhibited a specimen of a remarkable and little known Australian marsupial, *Antechinomys lanigera* (Gould).—A communication was read from Mr. L. Taczanowski, giving the descriptions of a collection of birds made in Northern Peru by Mr. Stolzmann during the last months of 1878 and the first half of 1879. Amongst them were examples of three species believed to be new to science, and proposed to be called *Turdus maranonicus*, *Arremon nigriceps*, and *Colaptes stolzmanni*.—Mr. Alfred E. Craven read descriptions of three new species of land and fresh-water shells, from Nossi-Bé Island, N.W. coast of Madagascar. —Mr. Craven also read a paper on a collection of land and fresh-water shells, made during a short expedition to the Usambara country, in Eastern Africa, with descriptions of seven new species.—Mr. F. Jeffrey Bell read some remarks in reference to certain statements made by Mr. A. Agassiz in a paper on the synonymy of the echini, communicated to the Society at a previous meeting.—Mr. W. K. Parker, F.R.S., read a paper on the structure of the skull in the chameleons.

Geological Society, March 10.—Robert Etheridge, F.R.S., president, in the chair.—John Ward was elected a Fellow, and Prof. F. von Hochstetter, of Vienna, and Prof. A. Renard, of Brussels, Foreign Correspondents of the Society.—The following communication was read:—On the geological relations of the rocks of the south of Ireland to those of North Devon and other British and Continental districts, by Prof. Edward Hull, F.R.S., Director of the Geological Survey of Ireland. In this paper the author, after referring to his previous paper on the geological age of the Glengariff beds (*Quart. Journ. Geol. Soc.*, vol. xxxv. p. 699), in which he showed that between them and the succeeding Old Red Sandstone in the south of Ireland there existed a very great hiatus, proceeded to compare the sections of the rocks of the south of Ireland with those of North Devon, and to show that the hiatus in question is represented in the latter locality by the whole of the Middle and Lower Devonian rocks. He then discussed the relations of the Devonshire rocks to those occurring north of the Severn, in Scotland, and in Belgium; and from this review of the whole question he arrived at the following conclusions:—1. That there is only one Old Red Sandstone properly so-called—represented in Devonshire by the Pickwell-Down Sandstone; in Ireland by the so-called Upper Old Red Sandstone, including the Kiltorcan beds; in Scotland by the so-called Upper Old Red Sandstone; and in Belgium by the "Psammites du Condroz." 2. That the so-called Old Red Sandstone of Herefordshire is the estuarine representative of the Middle and Lower Devonians of Devonshire; and that the so-called Lower Old Red Sandstone of Scotland, with its fish-remains, is the lacustrine representative of the Upper Silurian rocks. In conclusion the author discussed the physical conditions under which these various formations were deposited.

Physical Society, February 28.—Prof. W. G. Adams in the chair.—A paper was read by Mr. Ridout on some effects of vibratory motion in fluids. It was found by Savart and Tyndal that jets of water were sensitive to notes or air vibrations like flame, and the author conceived the idea of vibrating the jet of water internally. To do this he caused an electro-magnetic arrangement to pinch the tube, conveying the water 400 to 500 times per second, so as to communicate a vibratory motion to the stream of fluid. The issuing jet spread out in two streams, beautifully broken into drops, and representing the fundamental note. When the pinching lever vibrated irregularly harmonics were observed. When the water was thrown into vibration in two different planes, the resulting jet rotated in the tube. Froude's deduction that a liquid moving in a tortuous tube has a tendency to straighten the tube was illustrated by oscillating a pipette with its nozzle in a vessel of water, and filling a coloured liquid into it, which is seen to flow from the nozzle through the water in a tortuous line. By giving the pipette also a motion round its axis, the line becomes a spiral. A sounding body produces no disturbance in the stream. The author also showed that the cardboard experiment of M. Clement Desormes can be extended to water. In this experiment a cord is attracted to another cord by blowing a jet of air through the latter upon the surface of the former. Mr. Ridout allows a jet of water to flow out of a glass tube with a cup-shaped mouth upon the surface of a glass ball, and when the ball is within a certain distance of the mouth, it is attracted towards the latter and sticks in the mouth. In explanation of this fact it was shown that the ball and cup remained in such a position that the outflow of water was greater than if the globe had been entirely absent. Prof. Perry explained this action by the hydrodynamical fact that the pressure is less at the centre of the mouth of the cup than at the edges. Prof. Guthrie said that he had tried a similar experiment with a funnel-shaped mouth and a glass cone, but failed. He surmised that perhaps the cohesion of the water for itself, as it formed a shell round the ball, might help to cause the success of the ball method. Prof. Adams pointed out that with the cup and ball there was less difference of head of water between the centre of the mouth and the edge where the water escaped, than with the funnel. Dr. Stone stated that he had been able recently to imitate many physiological sounds, such as the murmur of the heart, by means of constrictions, in tubes through which water and air were flowing. His demonstrations were made before the Royal College of Physicians.—Dr. C. W. Wright then read an important paper on a determination of chemical affinity in terms of electromotive force. After giving a history of the subject, he described his original experiments. These consisted in performing electrolysis of sulphuric acid and measuring the heat evolved in the process, and by recombustion of the materials. A voltameter with spade-shaped platinum electrodes soldered to stout copper wires, and sealed by a large plug of gutta-percha, was employed for the electrolysis. An ordinary water calorimeter was used to measure the heat given off, as Bunsen's was found to contain sources of loss of heat. The strength of the current employed was varied from 6 webers to $\frac{6}{15}$ weber. The volume of gas produced was measured by Joules's plan. Radiation loss was corrected for by three methods. From an average of eighteen experiments the value of e, the electromotive force was found to be 1·5038 C.G.S.

or volts. Taking the formula $J = \frac{e}{(H+n)\chi}$, where J is Joules's equivalent, H is the heat actively evolved, n the heat evolved by recomposition, and χ a constant to which Kohlrausch gives the value of ·000105, Dr. Wright finds that Joules's equivalent should be $4{\cdot}196 \times 10^7$, instead of $4{\cdot}20 \times 10^7$, as given, to answer the formula. The author thinks that Joules's water-friction experiments gave the truest value of J, and that his electric heating experiments gave a result about $\frac{1}{2}$ per cent. too low, owing to the B.A. unit of resistance being about 2 per cent. too high and other causes.

Chemical Society, March 18.—Mr. Warren De la Rue, president, in the chair.—Prof. Tidy read a paper of over 100 pages on River-water. He discussed the subject under three heads:—1. Analytical details of river-waters. 2. The various sources of impurity to which river-water is subject, and the means whereby purity is maintained by nature or may be effected by art. 3. The extent to which statistics warrant us in condemning or in approving the supply of river-water for drinking-purposes. Under the first head the author gives detailed analyses of water from the Thames from 1876–1879; analyses are also given of water from the rivers Nile, Severn, and Shannon. Under the second head is discussed the effect (1) of flood-water, which at first deteriorates and then improves the quality of river-water; (2) of peat, the quantity of which in a water is kept in check by "a," the inherent power that water possesses of self-purification, owing to the oxidation of the peat by the oxygen held in solution in the water, and "b," mechanical precipitation by admixture with coarse mineral matter suspended in the water; (3) of sewage matter. This, in the opinion of the author, is a most vital question. From inspection of the effect produced by sewage on rivers, from analyses of the river-waters, and from experiment, the author concludes that the oxidation of the organic matter of sewage takes place, when mixed with unpolluted water and allowed a certain flow, with extreme rapidity. The various methods of artificial purification are discussed; of these filtration through sand is preferred. Under the third category the arguments for and against the use of river-water for drinking-purposes are examined: it is shown that the death-rates of towns supplied by wells and of those supplied by rivers are practically alike, and that in London there is very little to choose, as regards mortality, between districts supplied with well-water and those supplied by river-water; and while admitting that, as a matter of sentiment, he would prefer well-water, the author contends that there is no reason for supposing that the *materies morbi*, whether it exists as a germ or not, can resist oxidation, which is efficient in destroying other organic matter, as proved by chemical analysis. The author finally submits the two following conclusions:—1. That when sewage is discharged into running water, provided the dilution with pure water be sufficient, the whole of it, after the run of a few miles, will be efficiently got rid of. 2. That facts indicate that whatever may be the actual cause of certain diseases, the *materies morbi* which finds its way into the river is destroyed along with the organic impurity.

Meteorological Society, March 17.—Mr. G. J. Symons F.R.S., president, in the chair.—Sir A. P. Bruce Chichester, Bart., W. H. Cochrane, Rev. H. Garrett, M.A., H. Jonas, J. Lingwood, Lieut.-Col. L. W. Longstaff, Rev. C. E. Sherard, J. H. Stewart, and Dr. W. J. Treutler were elected Fellows of the Society.—The following papers were read:—Thermometric observations on board the Cunard R.M.S.S. *Algeria*, by Capt. William Watson, F.M.S.—On the Greenwich sunshine records, 1876-80, by William Ellis, F.R.A.S.—At 8 p.m. the discussion was suspended in order to afford the Fellows an opportunity of inspecting a large number of new and interesting meteorological instruments which had been brought together for exhibition.

Entomological Society, March 3.—H. T. Stainton, F.R.S., &c., vice-president, in the chair.—Dr. Hy. Chas. Lang, of 41, Berners Street, and Mr. Frank Crosbie, of Barnet, were elected Ordinary Members of the Society.—Mr. Pascoe exhibited several species of scorpions in reference to a statement recently made elsewhere that scorpions had been known to sting themselves to death when surrounded by fire. This Mr. Pascoe doubted, and showed that the two common European species, *Scorpio europæus* and *Buthus occitans* were almost physically incapable of effecting such a purpose.—Mr. Stevens exhibited a dwarfed female specimen of *Plebius icarus* (*Lycæna alexis*).—The Rev. A. E. Eaton exhibited several plates of drawings of *Ephemeridæ*, part of a forthcoming work, and contributed remarks thereon.—The Secretary exhibited, on behalf of Mr. Geo. Francis, of Adelaide, the microscopical specimens referred to at the last meeting of the Society.—Mr. Howard Vaughan exhibited a series of *Cidaria russata* from Yorkshire and the Isle of Arran, in illustration of local variation of the species.—The Rev. H. S. Gorham read a further communication on the *Lampyridæ*, and also a paper giving the result of his observations on these insects with respect to their phosphorescence, which he believed to be due to sexual causes. With regard to the typical species of the family, he observed that in the most highly organised genera, such as *Lamprocera* and *Cladodes*, the light-emitting faculty did not appear to be developed in proportion with the rest of the organs, and that the eyes were also reduced "in a direct ratio with the light," being small and uniform in both sexes, "whilst the antennæ were developed in an inverse ratio as the phosphorescence was diminished."—Mr. C. M. Wakefield communicated a paper by Mr. Fereday containing descriptions of new species of the family Lucanidæ and the genus Chlenius.—The following papers were also communicated:—On synonyms of heterocerous lepidoptera, by Mr. Butler; and descriptions of Cetoniidæ and Cerambycidæ, from Madagascar, by Mr. Waterhouse.

Photographic Society, March 9.—James Glaisher, F.R.S., president, in the chair.—A paper was read by the Rev. H. Lansdell, F.R.G.S., on a tour round the world, *viâ* Siberia and California, from which it appeared that photography in Russia and Siberia, in relation to its art-element, is in a very advanced condition. Some very interesting pictures of the eastern tribes of Russia and Siberia, bordering on China were shown, and also of the entire route, covering 25,510 miles.—A paper was also read by Capt. Abney, R.E., F.R.S., on the lateral spread of the image during alkaline development, showing that there was a travelling outwards of the deposit by alkaline development from the nucleus which forms the undeveloped image; this takes place in all directions, but when spreading laterally, it caused a blurring of the outline, seen in gelatine emulsion plates.

Institution of Civil Engineers, March 9.—Mr. W. H. Barlow, F.R.S., president, in the chair.—The paper read was on the purification of gas, by Mr. Harry Edward Jones, M.Inst.C.E.

Statistical Society, March 16.—Sir Rawson W. Rawson, C.B., K.C.M.G., in the chair.—Two papers were read, the first by Dr. T. Graham Balfour, F.R.S., on vital statistics of cavalry horses.—The second paper, read by Prof. Leone Levi, LL.D., was entitled a survey of indictable and summary jurisdiction offences in England and Wales, from 1857 to 1878, showing that the last twenty-two years have been on the whole favourable to the economic condition of the people, and the leading operating causes of crime have been less intense than in former years.

DUBLIN

Royal Dublin Society, February 16.—Physical and Experimental Science Section.—Wentworth Erck, LL.D., in the chair.—Physical observations of Mars, 1879-80, by Charles E. Burton, F.R.A.S. 22 sketches of the planet were obtained under favourable circumstances. To these Mr. Dreyer, of the Dunsink Observatory, added two, taken by himself with the "South" equatorial. The whole series, besides supporting the hypothesis that the principal markings are permanent as regards form and position, generally confirms the existence of the "canals" of Schiaparelli, adding perhaps a few which appear to have been detected for the first time in 1879, though it is not asserted that they are newly formed. The author's impression, from observation and comparison with earlier results, is that no rapid surface changes are now proceeding on Mars, and the great changes of appearance are due to formation and disappearance of cloud or mist in the planet's atmosphere. A number of areograpic positions of spots, determined by Kaiser's method, with the help of Marth's ephemeris, are included in the paper. The analogy between Mars and the earth is seemingly weakened by recent observations.—Notes from the Physical Laboratory of the Royal College of Science, by Prof. W. F. Barrett:—1. On the cause of the vibration in the Trevelyan rocker. The author attributes the motion to the force exerted by a thin layer of gas between the hot rocker and the cold support. As long as there is sufficient difference of temperature between the two surfaces, the supporting edges of the rocker are alternately repelled from the cool

leaden block in the same manner as the vanes of a radiometer are repelled from the relatively cool sides of the surrounding glass envelope.—2. On the effect of temperature on the illuminating power of coal-gas.—On a new harmonic relation between the lines of hydrogen, by G. Johnstone Stoney, D.Sc., F.R.S. The author pointed out that the stellar line H_1, which Mr. Huggins's investigations show to be probably a hydrogen line, stands in a simple harmonic relation with the known hydrogen line near G; H_1 being the 35th, and the line near G the 32nd, harmonics of a vibration the periodic time of which is $\tau \div 72 \cdot 003$, where τ is the time that light takes to advance a millimetre in air. The other known hydrogen lines, viz., C, F, and *h*, are already known to be the 20th, 27th, and 32nd harmonics of another vibration the periodic time of which is $\tau \div 76 \cdot 2$.—Natural Science Section, with which the Royal Geological Society of Ireland is associated.—G. H. Kinahan, M.R.I.A., in the chair.—The Chairman, as president of the Royal Geological Society of Ireland, delivered the anniversary address.—V. Ball, M.A., F.G.S., read a paper on the evidence in favour of the existence of floating ice in India during the deposition of the Talchir (Permian) rocks. In this communication the author gave a *résumé* of the facts which are held by Indian geologists to prove that during a part of the Talchir period the climate of Peninsular India was sufficiently cold, during the winters at least, to cause the formation of land-ice on the margins of the great lakes which then existed. The facts are similar to those employed to establish the glacial period of Europe. There is a boulder-bed which contains huge masses of rock enveloped in fine silt. In some cases it is demonstrable that these boulders have been carried from long distances in a direction contrary to the present slope of the surface. In others, but less commonly, polished and striated boulders have been found resting on scored and striated surfaces. The fossils of the Talchir rocks, consisting of a few ferns and equisitaceæ—all previous periods having been azoic—are not inconsistent with a mild, temperate climate. Reference was made by the author to the Karroo beds of South Africa and the Permian breccias of England, which are likewise believed to have had a glacial origin.

PARIS

Academy of Sciences, March 15.—M. Ed. Becquerel in the chair.—The following papers were read:—On a particular development of the perturbative function, by M. Tisserand.—On the compensation of temperatures in chronometers, by M. Phillips.—On the hypothesis of Laplace, by M. Faye. He shows the adverse bearing of various modern discoveries on it.—Reply to M. Berthelot's observations on hydrate of chloral, by M. Wurtz.—Action of oxygenated water on oxide of silver and on metallic silver, by M. Berthelot. Oxygenated water forms with silver oxide, in equal equivalents, a first unstable compound, $Ag_2O_3 3HO_2$, with separation of metallic silver. This is almost immediately decomposed into hydrated sesquioxide, water, and oxygen—with liberation of heat. If the silver oxide is in excess the action ends there; but if there is an excess of oxygenated water the sesquioxide acts in its turn on this, reproducing $Ag_2O_3 3HO_2$, which is again decomposed, and so on, till total destruction of the oxygenated water. The same theory accounts for the decomposition of oxygenated water in contact with metallic silver.—Memoir on the temperature of the air at the surface of the ground and to 36 m. depth, also on the temperature of two pieces of ground, one bare, the other covered with sod, during 1879, by MM. Becquerel. The results seem mainly to confirm those of previous observations.—Present state of the question as to the interoceanic canal; letter from M. De Lesseps to M. Larrey. He gives, among other news, a local account of the recent earthquake at San Salvador.—On a microphonic apparatus receiving speech at a distance, by MM. Bert and D'Arsonval. They use a plate of hardened rubber, through which passes the fixed carbon. The other carbon is carried by an iron rod which can turn about an axis, and whose mobility is regulated by a movable magnet. When the magnet is distant, the rod can turn on its pivot indifferently, but in the opposite case it is strongly directed, giving vibrations of very small amplitude and great rapidity. Speaking loudly at 4 or 5 m. from this instrument (or with low voice near), the speech is distinctly transmitted.—Practical rules for the establishment of telodynamic transmissions, by M. Léauté.—On the economic product of electric motors, and on measurement of the quantity of energy which traverses an electric circuit, by M. Deprez.—Laws concerning the distribution of the stars of the solar system, by M. Gaussin. Three more are given.—On the systems formed of linear equations with a single independent variable, by M. Darboux.—On the reduction of linear substitutions, by M. Jordan.—On the equation with partial derivatives of potential, by M. Picard.—On a new telemeter, by M. Landolt. This is based on the principle of refraction through a prism of variable angle, composed of two elementary prisms of the same power turning one on the other with the same velocity in opposite directions. The two have a central aperture concentric with the axis of rotation, and equal to half the surface of section of the bundle of luminous rays which enters the eye. The observer thus looks at once through the apertures and through the prisms. In one position of the prisms the object is seen simple, but on turning it is doubled, and from the amount of rotation necessary to bring the two images to a given position, the distance may be deduced. The instrument serves also for measurement of the size of inaccessible objects.—Application of the telephone to measuring the torsion of the motor-shaft of engines in motion, by M. Resio. Two similar copper wheels with equidistant palettes are fixed on the shaft, and turn before the core-ends of two similar bobbins wound oppositely, the wire forming part of a telephone circuit. While there is no torsion and the palettes therefore pass the cores simultaneously, the telephone is silent; but torsion makes it sound. By displacing the second bobbin on a graduated circle, silence is again had, and the amount of torsion can be estimated.—On a process for the measurement of high temperatures, by MM. Crafts and Meier. This is an adaptation of the gas-thermometer.—Electrolysis of malonic acid, by M. Bourgoin.—Synthesis of ulmic matters, by M. Millot.—On the products of decomposition of proteic matters, by M. Bleunard.—On the anatomical characters of the blood in phlegmasia, by M. Hayem.—On the digestive action of the juice of papaya and of papaïne on the sound or pathological tissues of the living being, by M. Bouchut. All organised tissues, even when living, may be peptonised by this substance (papaïne), which is the *vegetable peptone*.—On anchylostomiasis, by MM. Concato and Perroncito.—On the artificial production of felspars with base of baryta, strontia, and lead, corresponding to oligoclase, labradorite, and anorthite, by MM. Fouqué and Lévy. They operated by producing crystallisation at a high temperature, below the point of fusion, but near it.—Eruption and fall of volcanic dust at Dominica on January 4, by M. L. Bert. *Inter alia*, the cloud-carrying dust is shown to have travelled very slowly, though the wind was high.—Examination of the volcanic dust (just referred to) and the water which accompanied them, by M. Daubrée. The presence of innumerable crystals of pyrites in the powder is specially notable; also the presence of galena.—Separation of minerals whose density is greater than that of quartz with the aid of fused mixtures of chloride of lead and chloride of zinc, by M. Bréon.—*Aperçu* on the genesis of the mineral waters of Savoy, by M. Lévy.—Composition of the mineral waters of Bussang (Vosges), by M. Willm.

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